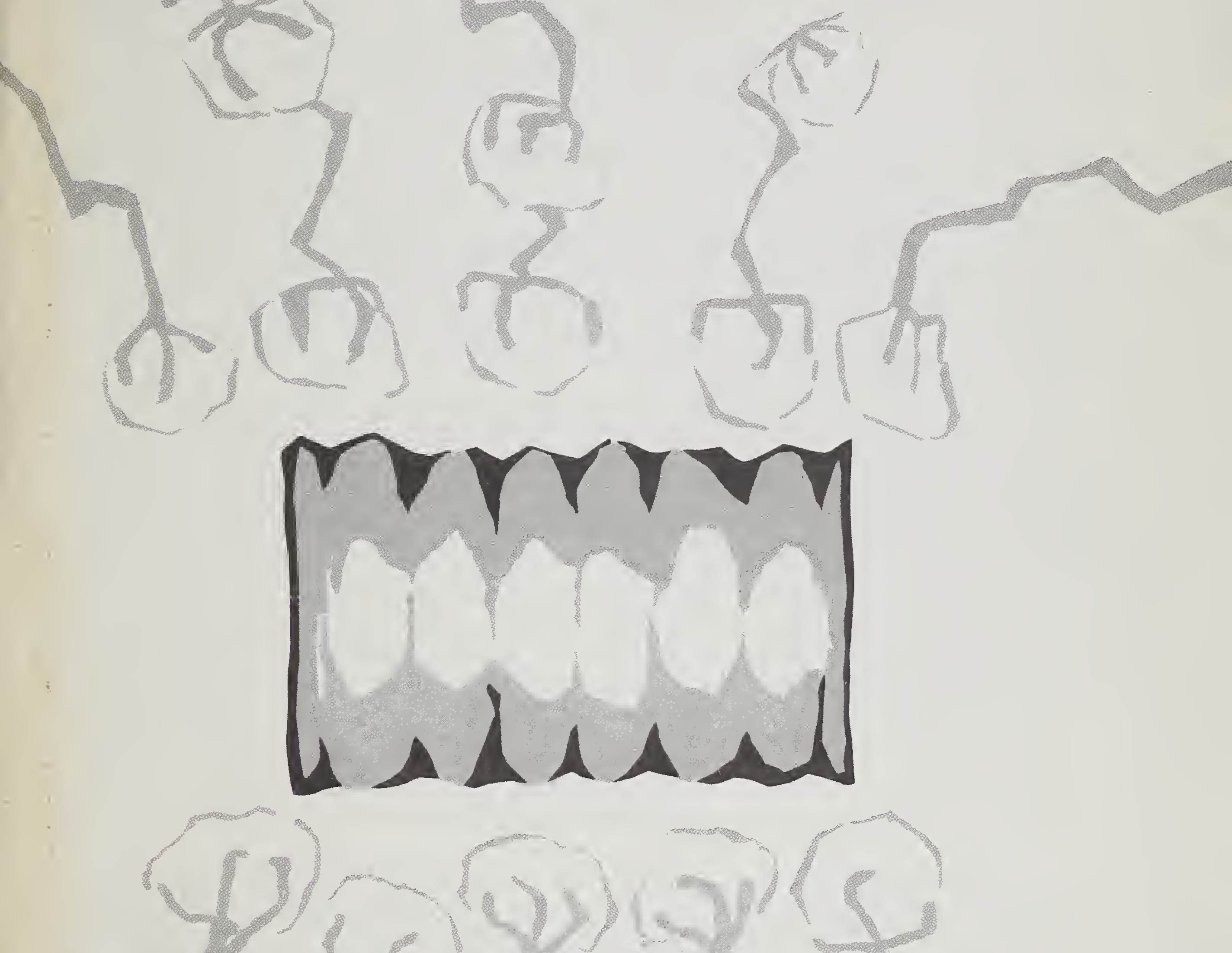
Cotton Production

CENTRAL COTTON GINNING

comparative costs, use in other countries, and potential use in the United States



FCS RESEARCH REPORT 4
FARMER COOPERATIVE SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

FARMER COOPERATIVE SERVICE
U.S. DEPARTMENT OF AGRICULTURE
WASHINGTON, D.C. 20250

Farmer Cooperative Service conducts research; advises directly with cooperative leaders and others; promotes cooperative organization and development through other Federal and State agencies; and publishes results of its research, issues News for Farmer Cooperatives, and other education material.

This work is aimed (1) to help farmers get better prices for their products and reduce operating expenses, (2) to help rural and small-town residents use cooperatives to develop rural resources, (3) to help these cooperatives expand their services and operate more efficiently, and (4) to help all Americans understand the work of these cooperatives.

JANUARY 1969

Preface

This publication reports the results of a study of central ginning, which includes the storage of seed cotton and other associated practices. Central ginning involves acquiring cotton from a wide area for ginning at a central point. The study was undertaken in an effort to analyze ways of reducing ginning costs and improving processing and marketing services. The findings indicate that central ginning is a promising way to achieve these goals.

Central ginning is a new method to most people in this country, but it is widely followed in foreign countries. The use of central gins in this country would require major changes in marketing practices, ginning operations, and customs. Opinions of those who are familiar with the idea and the potential application of central ginning range from very favorable to very unfavorable. These differences in views have tended to make central ginning a controversial subject even before it has been tried or tested. The use of central ginning in this country ought to be based on its economic value in comparison to other ginning methods.

One of the roles of research is to suggest new ideas and approaches. Frequently these suggestions lead to other areas of study or more detailed study. Thus, changes accompanying central ginning may call for studies of market structure and market relationships, of sampling and sample analysis, and of baling and storage.

Central ginning is promising enough to deserve complete and thorough testing in the United States. Its continued use in foreign countries shows it is practical under their conditions. Refinements in determining quality of seed cotton and the design of some new equipment will be needed for applying central ginning in this country. The necessary requirements can be obtained at reasonable cost through public or private research, experiments, tests, and pilot plant operations.

Acknowledgments

The author acknowledges and expresses thanks for observations and suggestions of representatives of State universities, agencies of the U.S. Department of Agriculture, and cotton industry organizations, including cooperatives.

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Summary and Conclusions

Because further increases in ginning costs in relation to the market value of cotton appear likely under the present or conventional method, a better ginning method that will reduce costs is urgently needed. Central ginning, a method widely practiced in foreign countries, has great potential both for reducing costs and for improving the quality of ginning services.

Central ginning is the method of gin operation by which gin owners acquire and store enough seed cotton to supply their gins for several months a year at capacity rates. Central ginning involves concentration of large volumes of seed cotton from a large surrounding area and requires purchases of seed cotton on the basis of seed cotton samples and their analyses for quantities of lint and seed and the quality of the lint.

Central ginning differs from conventional ginning in several ways. One important difference is that in central ginning, cooperatives and others buy or take title to harvested cotton before it is ginned; in conventional ginning, cotton is ginned for growers, and they retain title until after the cotton is ginned. Another difference is that at conventional gins, the cotton of individual growers is ginned separately and seldom mixed with other growers' cotton. At central gins, all seed cotton of the same grade or quality is stored, mixed, and ginned without regard to grower identification. Seed cotton goes to a gin or to market as soon as it is harvested. At conventional gins, it is generally ginned shortly after arrival, usually within 24 hours or less. The actual operating time of conventional gins totals about 1 month or less a year at capacity rates. Operation corresponds to the rate that cotton is harvested, and cotton harvesting depends on crop conditions, weather, and other variables. In contrast, central gins can operate regularly at near capacity rates since they operate mostly on stored seed cotton. Central gins would be capable of processing several times as much cotton a year as conventional gins of equal size or capacity. The larger quantity processed would affect both ginning costs and the quality of ginning services.

About 90 percent of the cotton grown in foreign countries in 1965-66 was sold by growers as seed cotton. About 85 percent of this, totaling 25 million bales, was ginned by the central method. These figures do not include Mainland China, for which data were not available.

Costs of central ginning in the Lubbock, Tex., area were projected by Farmer Cooperative Service in a 1963 study made at the request of a cotton cooperative. Data from this and other FCS studies and from reports on ginning practices in foreign countries indicate that cost of central ginning in the United States would be \$3 to \$7 a bale lower than cost of conventional ginning.

Lower labor and depreciation costs for central gins account for a large share of this difference. Conventional gins pay for considerable idle labor during unfavorable cotton harvesting weather and during the early and late weeks of the season. Central gins could operate at capacity regardless of how much seed cotton was received on any one day, and would have little idle labor. The larger volumes ginned would greatly reduce depreciation and other fixed costs per bale. Central gins would have lower costs than conventional gins on some other items, but they would have some additional

costs, such as for receiving stations. The estimate of $3 to $7 a bale savings with central ginning takes these additional costs into consideration.

Central gins have other advantages over conventional gins. For example, by blending seed cotton before ginning it is possible to produce large lots of cotton of uniform quality. In the study of central ginning in the Lubbock area, it was estimated that the value of lint could be increased by about $5 a bale by blending seed cotton.

Some problems will have to be solved if central ginning is adopted in this country. For example, to determine prices to growers, the seed cotton will need to be sampled, and samples analyzed for quantities of lint and seed and for fiber qualities.

Foreign practices and the work of agronomists and others in the United States show that seed cotton can be successfully classified. The problem of moisture may be solved by immediate ginning or otherwise handling of the small portion of seed cotton that contains too much moisture and storing the balance of the cotton for later ginning. Research pilot plants and equipment used for other purposes could, at a reasonable cost, solve the problems encountered in the application of central ginning.

Since about 1950, cotton prices have been declining. Meanwhile, the cost of ginning has been rising, and is now a major part of the cost of producing and marketing cotton. Cost of ginning amounted to over 12 percent of the combined market value of cotton and cottonseed from the 1966 cotton crop. In 1966, ginning charges were over $20 a bale in some States and averaged over $18 a bale for all States. Ginning charges of $20 a bale equal 4 cents per pound of lint, or 20 percent of the value of a bale when the price is 20 cents a pound.

CENTRAL COTTON GINNING:
Comparative Costs, Use in Other Countries, and Potential Use in the United States

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Costs of ginning cotton have increased until they are now a major expense in cotton production. They appear likely to increase further under present conditions and methods. Therefore, ways of preventing future increases and getting possible reductions deserve study.

This publication reports results of a Farmer Cooperative Service (FCS) study of a promising method for reducing ginning costs. The interests of cotton growers were of major concern in this study, since the growers pay the costs for ginning. However, interests of some other segments of the cotton industry, such as cotton ginners and cotton mills, were also considered.

The following examples of ginning charges, costs, and prices of cotton show why ginning costs are a problem of increasing importance.

For 27 cotton crops--from 1928 through 1954--ginning charges averaged 6.2 percent of the combined farm value of cotton and cottonseed (38, p. 3)[1]. But in 1966, these charges were estimated to average over 12 percent of the combined farm market value of cotton and cottonseed.[2] The percentages increased in 9 of the 12 years between 1954 and 1966, with the largest increase occurring in 1966 (32).

Gin charges were 50 percent higher in 1965 than in 1950, but the combined farm value of cotton lint and cottonseed was about 30 percent lower. Market prices and loan rates on cotton were considerably lower for the 1966 crop than for the 1965 crop but average gin charges for the United States increased from $17.30 to $18.30; for some States they were over $20 a bale. The base loan rate announced for 1967 was 0.75 cent a pound lower than for 1966, but the charges for ginning were expected to continue to increase.

Cooperative gins reduce ginning costs for members by refunding savings from gin charges and cottonseed margins. But in recent years, some cooperative gins have had costs which exceeded gin charges and margins on cottonseed. Low volumes at some cooperative gins in 1966 and prospects of low volumes at many

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[1] Numbers in parentheses refer to corresponding items in the Literature Cited (p. 30) of this report.

[2] Estimates for 1966 are based on 22 cents a pound for cotton, $70 a ton for cottonseed, and $18.30 a bale charge for ginning. The comparisons in this paragraph and the next one are based on prices received by farmers and do not include Government payments.

gins in 1967 do not appear favorable for reducing ginning costs for members.

Under the current conditions and outlook, members of cooperative cotton gins and other cotton growers in this country urgently need lower ginning costs. A previous study indicated that "central ginning" was a promising way of reducing ginning costs and also of improving the characteristics of the cotton by blending (15, pp. 2 and 23). This method is commonly followed in many foreign cotton-growing countries. The study reported here investigated central ginning more thoroughly than did a previous study (15) and in more detail.

"Central cotton ginning," as used in this report, means the method of gin operation, including storage of seed cotton and other associated practices, followed when cooperative or other gin owners centrally located in cotton producing areas acquire and store sufficient quantities of seed cotton to keep their gin, or gins, operating at capacity rates for several months a year. Large quantities of seed cotton would be concentrated in one location for central ginning rather than being dispersed as they are for conventional ginning. In this country, the quantity per central gin (or gin battery) would probably range from about 20,000 to over 50,000 bales a year and some firms would have more than a single gin at a central plant. In the 1960's, most new and relatively modern conventional gins in this country have been ginning between 3,000 and 8,000 bales a year, and all conventional gins have averaged 2,000 to 3,000 bales a year. Central gins in this country would process seed cotton from areas of about 30 to 150 miles in radius as compared with the 10-mile or less radius now served by conventional gins.

A gin, as used in this report, means a single complete unit for processing seed cotton into bales of lint and cottonseed. Such a unit is also sometimes called a gin battery. Most of the items of equipment in the central gins, assumed in this study, are standard items of gin machinery and identical to similar items in modern conventional gins. The relatively few differences between the equipment for the central gin and a modern conventional gin are discussed later. Otherwise, the central and conventional gins compared for the United States in this report are similar in size and equipment. The larger volume ginned by central gins results from operation at capacity rates for several months a year, mostly on stored seed cotton. Conventional gins operate intermittently as cotton arrives from nearby farms during the cotton harvesting season with their actual ginning time totaling about 1 month or less a year.

Central and conventional ginning differ in other ways. Cotton growers commonly sell most of their cotton shortly after it is harvested. Seed cotton delivered to conventional gins is ginned for the growers, usually within less than 24 hours and sometimes immediately. The weight of the cottonseed is estimated by use of a formula or the seed is actually weighed after cotton is ginned, and most cottonseed is sold to the conventional gins. The baled lint is weighed and samples are cut from sides of bales. Samples are then sent to Government classing offices for determination of quality, and when the classification or class cards are returned to the conventional gins, the growers may deliver the bale to a cooperative, or sell it to the gins or other buyers on the basis of the Government classification. Some growers sometimes hold their bales for a while or put them in the Government loan program and obtain a nonrecourse loan on them.

Cotton growers will likely continue disposing of most of their cotton shortly after it is harvested, no matter which method of ginning is followed. Consequently, central gin operators would have to acquire their supplies of seed cotton during the cotton harvesting season. A practical system for sampling and analyzing seed cotton would be necessary for the application of central ginning in this country. This system could be developed for determining weight and grade, staple, micronaire, and other fiber characteristics from seed cotton samples. Such a system is discussed later in the report.

Purpose and Method

The purpose of the study reported here was to evaluate central ginning, which includes seed cotton storage, as a means for reducing ginning costs of growers in the United States and of improving ginning services.

Specific subjects covered in this study were (1) the extent of central ginning in this and other countries; (2) costs of central ginning compared with those of conventional methods; (3) advantages of central ginning, such as improvement in uniformity of fiber properties by blending of seed cotton; (4) disadvantages of central ginning; (5) practices in foreign countries that are related to central ginning in this country; and (6) practices and problems involved in application of central ginning in the United States.

Primary data on costs and other aspects of central ginning were not available for the United States. In a few areas--in eastern Oklahoma and Virginia, for example--ginners buy substantial amounts of seed cotton. The volumes of seed cotton purchased, however, are not large enough for the operations to be considered central ginning.

In the absence of U.S. data for central gins, secondary data from other countries were used together with related data for this country.

Extent of Seed Cotton Sales and Central Ginning

A review of reports on foreign cotton ginning and marketing revealed considerable data on the extent of seed cotton sales and central ginning. Some data were found on sales of seed cotton in most cotton producing countries. Data on central ginning were less specific and complete.

In table 1, world production of cotton in 1965-66 is shown, except for an estimated 5.8 million bales produced in Mainland China. Also shown are estimated percentages of the 1965-66 crops that were sold as seed cotton in the various countries. Indications are that in Mainland China cotton is sold as seed cotton and that the central ginning method is followed.

It was estimated that about 90 percent of the cotton (excluding U.S. cotton) for which data were available was sold by growers before it was ginned--a total of about 30 million bales. Only growers in Peru and the United States had more than half their cotton ginned before they sold it. In all countries except the United States that produced over a million bales, 75 to 100 percent of the cotton was sold by growers before it was ginned.

Some of the seed cotton sold by growers was not ginned by the central method as that method is defined in this report. For example, in Uganda, all cotton was sold as seed cotton, but gins were numerous and cotton was ginned about as fast as it arrived at gins.

It is estimated that 85 percent of the cotton sold as seed cotton or about 25,500,000 bales, was ginned by the central method and 15 percent was ginned by other methods. On that basis, 54 percent of all cotton covered in table 1 (including U.S. production) was ginned by the central method.

The production of cotton in small plots producing less than a bale has sometimes been considered the reason growers sell cotton as seed cotton. While this was probably one of the factors responsible for sales of unginned cotton in some areas, it did not account for this practice in many other areas. For example, "The scale of operation in Colombia is sufficient to permit use of the U.S. system, but cotton is sold in the seed" (76, p. 13). Growers in the Managua area of Nicaragua average 75 acres

Table 1.--Cotton production of major cotton producing countries (excluding Mainland China) and estimated percentages and bales sold by growers before and after ginning, 1965-66

Countries	Production 1965-66[1]	Estimated percent sold[2]--		Estimated bales sold--	
		As seed cotton (before ginning)	As lint cotton (after ginning)	As seed cotton (before ginning)	As lint cotton (after ginning)
	1,000 bales	Percent	Percent	1,000 bales	1,000 bales
Argentina	525	65	35	341.2	183.8
Brazil	2,450	95	5	2,327.5	122.5
Colombia	300	100	-	300.0	-
El Salvador	240	100	-	240.0	-
Greece	340	50	50	170.0	170.0
Guatemala	400	70	30	280.0	120.0
India	4,600	98	2	4,508.0	92.0
Iran	645	90	10	580.5	64.5
Mexico	2,615	75	25	1,961.2	633.8
Nicaragua	510	70	30	357.0	153.0
Pakistan	1,925	98	2	1,886.5	38.5
Peru	575	40	60	230.0	345.0
Spain	375	95	5	356.2	18.8
Sudan	750	100	-	750.0	-
Syria	830	100	-	830.0	-
Tanzania	315	90	10	283.5	31.5
Turkey	1,500	85	15	1,275.0	225.0
Uganda	375	100	-	375.0	-
UAR	2,398	95	5	2,278.1	119.9
USSR	8,800	100	-	8,800.0	-
Others	2,047	90	10	1,842.3	204.7
Subtotal	32,515	92.2	7.8	29,972.0	2,543.0
U.S.A.	14,920	0.3	99.7	44.8	14,875.2
Total	47,435	63.0	37.0	30,016.8	17,418.2

[1] Source: Cotton Monthly Review of the World Situation (22, p. 4, table 2).

[2] Estimated percentages for the various countries are based largely on the following references from the Literature Cited list, page 30. Argentina--64, pp. 12 and 13; 98, p. 98. Brazil--77, p. 13; 8, pp. 27,51, and 53. Colombia--76, p. 13. El Salvador--88, pp. 18-20; 67, pp. 10 and 11. Greece--17, pp. 140 and 141. Guatemala--88, p. 33; 67, pp. 2 and 20. India--45, p. 8; 28, pp. 114-116; 54, p. 211; 19, p. 39. Iran--66, p. 15. Mexico--46, p. 8. Nicaragua--88, pp. 9 and 10; 67, p. 31. Pakistan--65, pp. 7, 8. Peru--8, p. 135; 21, p. 17. Spain--89, pp. 13 and 14. Sudan--78, p. 29; 25, p. 33. Syria--47, p. 4; 66, p. 15. Tanzania--78, pp. 25-28. Turkey--48, pp. 10, 11. Uganda--26, p. 40; 78, pp. 25 and 26. UAR--78, p. 28; 27, pp. 72 and 28; and 25, p. 33. USSR--72, pp. 14 and 15; 92, pp. 6 and 7; 68, pp. 22 and 23. United States--32. Others--44, pp. 4 and 5; 78, pp. 25-28; 29; 30; 8.

each (88, p.5). In El Salvador, "Much of the cotton is produced on large farms..." (88, p. 14). "Cotton farming in Guatemala is on a large-scale commercial basis for the most part, although some cotton is grown on small family type units" (88, p.26). In the Chaco area of Argentina, "Farmers in the east plant an average of 30 to 40 acres of cotton, while some farmers in the west plant from 100 to 250 acres" (64, p.2). In all these countries, growers sell a large part or all of their cotton before ginning it.

In the USSR, cotton is grown on large state and collective farms. Overby reported that in 1959 cotton production in Russia was similar to that in our western United States (72,p.14). In Russia, 120 gins processed close to 7 million bales a year in the late 1950's, an average of close to 60,000 bales each (72,p.15). Cotton in Russia is sold or transferred from farms as seed cotton to the Government cotton agency.

Other large cotton-producing countries where growers sell all or most of their cotton before it is ginned include Brazil, India, Mexico, Pakistan, Sudan, Turkey, and the United Arab Republic. In 1965, the Sudan produced 750,000 bales, all of which were sold as seed cotton. Mexican and Pakistani growers were estimated to have sold nearly 2 million bales each as seed cotton in that year. Turkey produced about 1.5 million bales, and growers were estimated to have sold about 85 percent, or about 1.25 million bales, as seed cotton. Brazil, India, and the United Arab Republic each had over 2 million bales sold as seed cotton.

Potential Cost Reductions from Central Ginning

Charges to U.S. growers and costs to growers or ginners for ginning seed cotton, comparable charges and costs in countries where central ginning is common, and projected central ginning costs in Texas are discussed in this section. The economic basis for the differences is examined.

Part of the data used in this section were reported as gin charges, and the other were reported as gin costs. The term "gin charges" refers to the amounts charged cotton growers or others by gin owners for ginning, including pressing and bagging and ties. The term "gin costs" refers to the expenses or costs of owning and operating gins. As information was not available on both charges and costs for all the comparisons needed, either charges or costs were used in specific comparisons, depending on how the data were reported.

Ginning Costs and Charges in the United States and in Other Countries

Data on costs and charges for central and conventional ginning in foreign countries were more limited than were conventional ginning charges and cost data for the United States. More data were available for India than for any of the other countries.

INDIA

Central ginning is generally followed in India. Ginning and pressing of lint are frequently performed by separate firms, whereas, in the United States, ginning includes pressing.

A study of marketing in India in the 1955-56 season showed that processing margins (similar to gin charges in the United States) for ginning and pressing in five States ranged from 2.68 to 6.38 percent of the price of cotton in consuming centers (19, p.41). Table 2 shows these processing margins as percentages of producers' shares, which are similar to prices received by farmers in the United States. The average for the five Indian States was 4.67 percent.

Ginning charges in the United States, including pressing, bagging, and ties, averaged $12.75 a bale (32) or 7.89 percent of the price growers received in 1955 (table 2). Ginning charges equal to 4.67 percent of that price (the average charges in India) would have been $7.55 a bale, or $5.20 less.

The most nearly comparable prices available for 1955 on similar Indian and U.S. cotton were for Broach Vijay fine in Bombay and SLM 15/16" in New Orleans (33, p. 163, footnote 4). The price growers received for the Indian cotton was 26.74 cents a pound, or $133.70 for a 500-pound bale. This price indicates that ginning charges (at 4.67 percent of price) were around $6.25 a bale. The price of the U.S. cotton was 33.35 cents a pound on a net weight basis, or $166.75 a bale. Average ginning charges of $12.75 a bale in the United

States for 1955 were a little more than twice the charges for the most nearly comparable Indian cotton.

Table 2.--Percentage processing costs (ginning and pressing charges) were of the price producers received, selected States, India and United States, 1955-56[1]

Country and State	Processing costs	Country and State	Processing costs
India	Percent	United States	Percent
Madyha Pradesh	5.67	Alabama.	5.30
Madras.	3.42	California . . .	8.37
Mysore	7.73	Mississippi . .	6.72
Gujarat	2.93	Missouri . . .	10.39
Punjab	3.61	Texas	9.24
Average, 5 States	4.67	Average, 5 States	8.00
		All States, U.S.A. . . .	7.89

[1] Sources of data used for calculations: 19, table 4, p. 41 for India; 32 and 33, p. 54 for United States.

The Directorate of Marketing and Inspection in India made a study of price spreads in 1958-59 in areas where cotton cooperatives were active. The costs found in that study, converted to percentages of prices received by growers, are shown in table 3. Both processing costs and cost of assembling seed cotton in local village markets and moving to secondary markets or assembling or buying from growers at secondary markets, were included. Many gins are located at secondary markets. Assembly at secondary markets would be similar to delivering to warehouses in the United States.

The costs for ginning, other than assembling costs, ranged from 3.87 to 5.36 percent of prices growers received and averaged 4.68 percent. Combined assembling and ginning costs ranged from 4.66 to 7.76 percent of prices growers received and averaged 6.07 percent.

Table 3.--Ginning, pressing, and assembling costs as percent of prices received by growers in States where cooperative societies operated, India, 1958-59[1]

States	Costs as percent of producers' shares		
	Ginning and pressing	Assembling	Total
		Percent	
Surat.	4.80	0.99	5.79
Abohar . . .	3.87	0.79	4.66
Gadag. . . .	5.36	2.40	7.76
Average, 3 States . .	4.68	1.39	6.07

[1] Source of data used for calculations: 19, table 5, p. 42.

Average ginning costs per bale on the 1958 crop are shown in table 4 for three groups of cooperative gins in the United States. These costs ranged from 8.50 to 11.47 percent of the prices growers received for their cotton and averaged 9.78 percent. The unweighted average ginning cost of $15.79 equaled 9.50 percent of bale value of $166.15 at the average price of 33.23 cents a pound received by U.S. farmers in 1958.

Table 4.--Average ginning costs per bale and percent ginning costs were of average prices received for cotton by 3 groups of cooperative gins, in the United States, 1958 crop

Cooperative gin group	Cost per bale	Cost as percent of price received by growers
	Dollars	Percent
Group 1 . . .	14.61	9.36
Group 2 . . .	14.85	8.50
Group 3 . . .	17.90	11.47
Average, 3 groups . .	15.79	9.78

At a price to growers of 30 cents a pound, the cost of assembling and ginning in the Indian areas studied would have been $9.10 a bale--6.07 percent of the price received by growers. At a price to growers of 30 cents a pound, in

the United States the cooperative gin groups studied would have had a cost of ginning of $14.67 a bale--9.78 percent of the price received.

OTHER FOREIGN COUNTRIES

In Nicaragua, the charges to the growers who had their cotton custom ginned ranged from $11.50 to $13 a bale (88, p.10) compared with an average of $17.08 a bale in the United States on the 1962 crop (32). Ginning machinery and equipment used in Nicaragua was all manufactured in the United States. The 28 gins in Nicaragua averaged slightly over 12,000 bales each from the 1962 crop. Central ginning methods were followed on a little over two-thirds of the crop, according to estimates in table 1. Competition among central gins and among central gins and other buyers to buy from growers apparently influenced charges to growers for ginning.

Ginning charges in Guatemala were quoted at 2.8 and 2.9 cents a pound of lint or about $14 a bale for the 1962 crop (88, p.31). The 21 gins averaged about 11,900 bales each in 1962. The extent of central ginning was estimated to have been similar to that of Nicaragua, and its influence on charges to growers appear similar. Gin charges in Guatemala were about $3 a bale lower than the U.S. average of $17.08 in 1962.

Ginning charges in Egypt for 1947 were reported to have been $7 for a 500-pound bale of long staple cotton (27, p.73). That charge included unloading the seed cotton at the river wharf, blending, ginning, and baling. Gins in Egypt were roller type. Wage rates were low in Egypt but large numbers of workers were employed, and ginning labor cost about $5 a bale. Average gin charges for roller ginning American-Egyptian (long-staple) cotton in the United States in 1947 were $15.47 for a 500-pound bale (38, p.11), over twice as much as in Egypt. Average gin charges in the United States were $9 a bale on upland (short-staple) saw-ginned cotton in 1947, $2 more a bale than for roller ginning long-staple cotton in Egypt.

Projected Costs of Central Ginning in Texas

Data from FCS Service Report 67 (15) and various other sources have been combined to develop table 5 which shows estimated costs per bale for various items and total costs for the same items. The costs used in this table for conventional gins were those estimated in a report based on a survey of cooperative gins in the Lubbock area of Texas, for a 10-bale-per-hour size gin on a volume of 6,000 bales a season (14, p. 12. table 9). A gin of this size has sufficient capacity to gin an average of 10 bales an hour after including stops of 1/2 to 1 hour in each 24 hours for maintenance. This measure of size or capacity is based on amount of cotton actually ginned rather than on manufacturer's ratings. Cooperatives usually gin from about 55 to over 80 percent of their volumes for a season in about 21 days. Their members become dissatisfied with the length of time they have to wait for trailers when cooperative gins of the 10-bale-per-hour size gin over about 6,000 bales a season. For that reason, the 6,000 bale volume was selected. Costs for other conventional gins may differ from those shown in table 5, especially if sizes of gins were determined in a different way and if volumes for the season were different.

Data for the 1963 crop were used, since data were not available on some items for a more recent date. Data in table 5 cover receiving station costs in some detail and they also include costs for estimated sample ginning, storage, compression, and additional hauling. Further details are given in tables 8 through 13 and in section 1 of the appendix.

GINNING COSTS

In FCS Service Report 67 (15), ginning equipment used in estimating central and conventional ginning costs was assumed to be identical, but some changes were made in the assumptions for the central ginning equipment as listed in table 8 of this report.

Table 5.--Estimated costs for conventional and central ginning and handling of 36,000 bales of cotton, Lubbock area of Texas, 1963 crop[1]

Items	Estimated costs per bale for--		Estimated seasonal costs for--		
			Conventional ginning		Central ginning
	6 conventional gins [2]	1 central gin with 7 receiving stations	1 gin, 6,000 bales [2]	6 gins, 36,000 bales	1 central gin with 7 receiving stations
	Dollars	Dollars	Dollars		Dollars
Ginning costs:					
Variable gin costs:					
Manager's salary	1.00	0.33	6,000		12,000
Office salaries	0.55	0.55	3,300		19,800
Gin labor	3.65	1.50	21,900		54,000
Office supplies	0.20	0.20	1,200		7,200
Repairs and supplies	1.50	1.00	9,000		36,000
Power	1.65	0.52	9,900		18,720
Fuel and water	0.30	0.15	1,800		5,400
Other	0.85	0.45	5,100		16,200
Total variable gin costs	9.70	4.70	58,200		169,320
Fixed gin costs:					
Depreciation	3.38	0.64	20,280		22,870
Interest on investment[3]	1.29	0.24	7,740		8,665
Taxes, ad valorem	0.28	0.05	1,680		1,885
Insurance	0.17	0.03	1,020		1,150
Total fixed gin costs	5.12	0.96	30,720		34,570
Total ginning costs for 1 gin	--	5.66	88,920		203,890
Total ginning costs	14.82	--	--	533,520	203,890
Receiving station costs[4]					(On 5,143 bales
Variable station costs (for 1 station):					
Labor	--	0.88	--		4,536
Power	--	0.32	--		1,646
Wire (for baling)	--	0.60	--		3,086
Repairs and maintenance	--	0.33	--		1,694
Total variable station costs	--	2.13	--		10,962
Fixed station costs (for 1 station):					
Depreciation	--	0.77	--		3,952
Interest[3]	--	0.32	--		1,661
Taxes, ad valorem	--	0.07	--		338
Insurance	--	0.04	--		203
Total fixed station costs	--	1.20	--		6,154
Total station costs	--	3.33	--		17,116
Total costs of 7 stations					119,812
Additional hauling costs[5]	--	0.18	--		6,480
Sample analysis, ginning portion[6]	--	0.25	--		8,966
Costs for storage, compression, and associated services[7]	3.42	2.92		123,264	105,062
All costs	18.24	12.34		656,784	444,210

[1]Costs are for the period October 1, 1963, to May 1, 1964. They include storage, compression, and associated services. Costs for 6 conventional 10-bale-per-hour gins are compared with estimated costs for 1 10-bale-per-hour central gin with 7 10-bale-per-hour receiving stations.

[2]Costs for conventional gins were taken from Marketing Research Report 640 (14, table 9, p. 12) and were based on a survey of 13 cooperative gin associations in the vicinity of Lubbock, Texas.

[3]Interest on investment is a return on capital--not an expense, but it is included here in expenses to make results more comparable on different total investments. The investment was $1,800,000 for 6 conventional gins at $300,000 each compared to $337,000 for a central gin plus $430,220 for receiving stations, and $12,500 for the ginning portion of a seed cotton sample analysis system, or a total of $779,720.

[4]The 7 stations averaged 5,143 bales each. See table 9 and section I of the appendix for details.

[5]Cost estimated for hauling 5 percent of original burs and trash mixed with cotton brought to receiving stations (or 40 pounds a bale) and 1 pallet per bale (estimated to weigh 60 pounds). For source of rate (18 cents per 100 pounds) see FCS Service Report 67 (15, table 9, p. 17).

[6]For details, see table 11 and appendix, section I.

[7]For details, see tables 11, 12, and 13 and appendix, section I.

These changes are discussed briefly in section I of the appendix. The major change was the inclusion of a high density gin bale press in the central gin. The changes increased the investment in the central gin to a total of $337,000 as compared with $300,000 for the conventional gin.

Comparison of costs per bale for ginning at the conventional gins and the central gin show some important differences.

One major difference is in the cost of labor. The hours of labor estimated for the conventional gin were the average for single gins and lower than for all 13 gins in the survey of cooperative gins in the Lubbock area of Texas (14, pp. 14 and 24). The estimated labor used at the central gin was also partly based on the survey of those same cooperative gins. This survey showed that less than 1 hour of labor a bale was used in the peak week of ginning. (14, p. 14).

Another factor influencing the labor cost assumption for the central gin was that it could operate continuously at closer to maximum capacity than could conventional gins. Weaver and McVey found that five-stand batteries in the Lubbock area of Texas ginned machine-stripped cotton an average of about 70 percent of the time cotton was available and ginned hand-harvested cotton an average of a little over 80 (81.5) percent of the time (99, table 2, p. 5). More recently, Griffin and Looney found that six gin plants averaged ginning cotton from 58 to 93 percent of the total time the gins were running (43, pp. 24, 26, 52, and 53). The plant reported by Griffin and Looney as ginning during the lowest percentage of its running time was occasionally used for demonstrations. This usage, they indicated, probably accounted for the low percentage. The plant ginning during the highest percentage of running time was one used by a partnership where a few pounds of one partner's cotton going into the other's bale was of no consequence and no time was lost between loads, except when the condition of new loads made it advisable to readjust cleaning and drying equipment. The six conventional gins actually ginned about 80 percent of their total running time.

A central gin could operate continuously on lots of a hundred or more bales of cotton in about the same condition. Cotton for central ginning would have more uniform moisture content than cotton coming to conventional gins from trailers, and fewer adjustments would be needed on dryers (if used) and cleaners for large lots. Consequently, it is estimated that the central gin could actually gin about 15 percent more of the actual ginning time than could conventional gins. The rate of ginning of the central gin in table 5 was assumed to be 15 percent higher than that of conventional gins. At that rate it would gin 11.5 bales an hour.

One more man was needed for operating the central gin than the conventional gin on account of the high-density gin press in the central gin, but the higher ginning rate slightly more than offset the difference in labor cost. Labor costs for the central gin were estimated at $1.50 an hour and $1.50 a bale.

More than $1 a bale difference is shown in table 5 for costs of power for the conventional gin and the central gin. The cost of power for the conventional gin is the same as used in Marketing Research Report 640 (14, pp. 26-28).

Central gins would have a pattern of operation and electric power consumption similar to cottonseed oil mills, in that they would often have about 5 to 10 months or more of operation at near capacity rates. Some electric rates that apply to oil mills now also apply to cotton gins. Some electric firms offer the customer an opportunity to choose among rate schedules, one of which may be the schedule already used by oil mills. Since central gins would use electric power similar to the way it is used by cottonseed oil mills, they could likely persuade most power companies to let them have the same rates as oil mills get.

Perdue compared oil mill power costs of 14 oil mills under 14 electric rate schedules for each mill (75, table 1, p. 3, and appendix

table 1, pp. 26-28). Although kilowatt demand is usually a factor in charges for electric power, a simplified comparison of kilowatt hour costs indicate that oil mills averaged from about 0.96 to 1.40 cent a kilowatt-hour calculated on energy alone.

It happens that Lubbock, Tex., had comparatively low electric rates for oil mills, but some other locations had somewhat lower rates. The electric rates in Lubbock, shown in the National Electric Rate Book for Texas, 1960, are the same as the rates that applied to oil mills and gins in Lubbock in 1963 (36). The rates in Lubbock averaged about 1 cent a kilowatt-hour after discount, and 1 cent a kilowatt-hour was used for calculating the central gin's power cost.

The conventional gins in the Lubbock area included in Marketing Research Report (MRR) 640 (14) used 60 kilowatt-hours a bale.

It was estimated that a receiving station would use about 11 kilowatt-hours a bale for unloading, cleaning, extraction of burs and trash, and bailing. The central gin would require 10 kilowatt-hours less than the conventional gin as the unloading, cleaning, and extracting would be done by receiving stations rather than at the gin. To the remaining 50 kilowatt-hours for the central gin, 2 kilowatt-hours were added for the high-density gin bale press (13, appendix table 12, p. 42), which made a total of 52 kilowatt-hours at 1 cent, or 52 cents power cost a bale.

Table 5 shows cost per bale attributable to manager's salary for the central gin to be only one-third of the cost for the conventional gin even though the yearly salary is twice as high at the central gin (table 5).

Repair and supply costs for the central gin were estimated at $1 a bale or 50 cents less than for the conventional gin. Supplies would be purchased in larger volumes for central gins. Repairs would be mainly replacements, due to wear, rather than the seasonal overhauls and replacements of parts only partly worn out to make them ready for the peak period--a practice sometimes followed at conventional gins.

Table 5 shows total variable costs of $4.70 a bale for the central gin compared with $9.70 for the conventional gin, a difference of $5.00 a bale.

Total fixed costs were over five times as much per bale for the conventional gin as for the central gin (table 5). This cost difference was primarily the result of differences in volumes--6,000 bales for the conventional gin compared with 36,000 bales for the central gin. Although the volume ginned by each conventional gin was one-sixth that of the central gin, the fixed costs for the six conventional gins were not six times as large as for the central gin because of the larger investment in the high-density press and the addition of magnet and seed cotton blending equipment for the central gin.

The major difference in fixed costs was in depreciation, with $3.38 a bale for the conventional gin and $0.64 for the central gin. However, the receiving station costs would have to be included to make a complete comparison of the methods. The depreciation on the central gin of $0.64 a bale and of $0.77 a bale on receiving stations makes a total of $1.41, or $1.97 a bale less for the central gin. This reflects the difference in investments to a large extent. Depreciation of $0.03 a bale was also estimated on the sample ginning equipment for the central ginning system (table 10), which would reduce the total difference in depreciation to $1.94 a bale. That makes a total depreciation of $1.44 a bale for the central ginning system compared with $3.38 for the conventional gin.

Interest on investment is included in costs, in recognition of substantial differences between total investments of the two systems. (Interest on investment is really a return to capital rather than an expense.) The total investment required for six conventional gins at $300,000 would be $1,800,000. The total investment required for one central gin costing $337,000, plus 7 receiving stations at $61,460

(table 9), or $430,220, plus seed sample ginning equipment and building costing an estimated $12,500, makes a total of $779,720. These estimates indicate total investments of about $1 million less for the central ginning system than for six conventional gins.

RECEIVING STATION COSTS

Receiving station costs were a substantial amount, totaling an estimated $3.33 a bale and equaling about 60 percent of the central ginning cost of $5.66 cents a bale (table 5). Cost of labor, wire for baling seed cotton, and depreciation were the largest items, and those three items accounted for $2.25, about two-thirds of the total $3.33.

For details on receiving station investments and operating costs, see section I of the appendix and table 9.

STORAGE, COMPRESSION, AND ASSOCIATED COSTS

The costs of storage, compression, and associated services were estimated to total $3.42 a bale for conventionally ginned bales and $2.92 a bale for the centrally ginned bales, (table 5). Storage costs and part of the other costs were higher on centrally ginned bales than on conventionally ginned bales. However, this difference was more than offset by the advantage of lower costs for compression on the centrally ginned bales, resulting from the use of the high density press in the central gin.

Details on assumptions, and calculations used in determining the total costs for storage, compression, and associated services are discussed in section I of the appendix and shown in tables 11, 12, and 13.

OTHER COSTS

The additional hauling costs (for burs, trash, and hauling pallet) were based on the average hauling rate of about 18 cents a hundred pounds, as developed in Service Report 67 (15, table 9, p. 17) from combining prevailing rates for baled lint and cottonseed. It was estimated that 5 percent (or 40 pounds) of the 800 pounds of burs and trash in a bale of machine-harvested seed cotton would remain after the cleaning and extraction process at receiving stations. The pallet used for hauling each bale was estimated to weigh 60 pounds, making a total of 100 pounds a bale in addition to lint and cottonseed, and would amount to 18 cents extra hauling charge a bale.

The analysis of seed cotton samples would include determinations of the percentages of lint and seed in each sample and of the quality of the lint. The seed cotton sample would be weighed and ginned, and then the resulting lint and seed would be weighed. The percentages of lint and seed would be calculated from these weights. The lint from the seed cotton sample would be classed for quality at the same cost as for samples from conventionally ginned bales. Therefore, only the cost of ginning the seed cotton samples would be an additional cost for the central method of ginning.

It was estimated that the ginning portion of seed cotton sample analysis would cost 25 cents a bale (table 5). The estimated investment required for sample ginning equipment and building space and its estimated operating costs are shown in table 10 and discussed in more detail in section I of the appendix.

Other Aspects of Central Ginning in the United States

In addition to lower ginning costs, central ginning has several other advantages over conventional ginning. Blending of seed cotton before ginning is perhaps the most important of these. Another is improved fiber quality preservation through better control of moisture in seed cotton.

Related to the reduction in costs are the increased rates of ginning and handling of cotton and the reduction in seasonality of operations and in idle labor. Other advantages of central ginning are improved ginning, packaging, and sampling; better preservation of bale coverings; more uniform weights of bales; elimination of two-sided bales; and better seed weight and fiber quality determination.

Disadvantages that have been cited for central ginning are the problems associated with growers' sale of seed cotton and the possibility that excessive moisture could cause damage to stored cotton.

Blending

Blending of seed cotton opens a new potential for cotton marketing and for scientific operation of central gins.

Cotton fibers differ among varieties, within a given variety; from area to area; on adjoining farms; among bales from a given variety on a farm, from stalk to stalk of a given variety; and even among bolls from the same stalk, locks of a boll, and fibers from a seed. All mills blend cotton from several bales to obtain more uniform quality of cotton and yarn. Preblending cotton after it leaves gins but before final blending at the mill has been credited with improving levels of mill performance by helping to maintain an average level of fiber properties in mix from day to day, week to week, and month to month (24, pp. 28-30). Many of these advantages could be obtained at central gins by proper mixing of seed cotton before ginning.

Lint can be blended to obtain the fiber properties needed to produce satisfactory quality but keep costs down. Characteristics of cotton for lint blending may vary considerably. Lint blending improves the final product, stabilizes variation among bales, and makes buying easier for mills (12, p. 18; 49, p. 44). Blending of seed cotton could produce similar results.

The average dollar amount by which proper blending at gins would increase the value of cotton in this country is not known. In the projection of central ginning costs in the Lubbock area of Texas, however, it was estimated that blending would add $5 to the price of cotton per bale in that area (15, p. 23).

Fiber Quality Preservation

Storage of seed cotton for central ginning offers a potential means of improving moisture control in seed cotton.

In some areas, the use of gin dryers may be omitted when seed cotton is stored. The percentage of moisture declined about 5 percent in seed cotton stored in hay bales in New Mexico (1, p. 182). Stored cotton can be dried slowly in various ways.

Entire bales are now ginned in about 3 to 15 minutes, and the contact of individual locks with heated air in dryers varies with types of dryers. Exposure time per dryer is about 12 to 16 seconds in the most common type of dryer but ranges from about 2 seconds to about 2 minutes in other types of dryers. Since moisture percentages of seed cotton, as delivered to gins, may vary greatly within a trailer load, a ginner may overdry some cotton in order to dry the rest sufficiently. Moisture becomes more evenly distributed in stored seed cotton so that less variation in temperature is needed than for recently harvested cotton if driers are required.

Excessive moisture apparently contributes to damaging of stored seed cotton under some conditions. However, most of the cotton in foreign cotton-producing countries is stored as seed cotton, and little damage has been reported. Data presented later in this report indicate that most of the cotton in the United States is likely dry enough when delivered to store without damage. Methods can be found to prevent damage to the seed cotton that has a high moisture content when delivered. Excessive moisture is a problem subject to solution rather than an obstacle that would prevent central ginning.

Increased Efficiency with Central Gins

Some of the inefficiencies of conventional ginning have been recognized for some time. In 1945, the basic inefficiency of loss of ginning time between loads brought to conventional gins by different farmers was contrasted with the steady operation of central gins in Brazil (39, p. 143). In 1956, the seasonality of ginning in the United States was reported to be one of the major factors limiting the efficient operation of gins, and it was considered the source of labor problems such as those related to the hiring of unskilled workers (10, p. 24).

In 1963, two ginning engineers, in a discussion of the development program under way to make ginning more efficient and less costly, described the gin of tomorrow. Their description included the statement that a large storage facility would be adjacent to the gin plant and that this would enable the ginner to handle a larger volume of cotton. (60, p. 30).

The buying and storing of seed cotton for central ginning makes it possible to gin cotton at capacity rates, thereby increasing efficiency and reducing costs.

Receiving stations for central gins could handle seed cotton as fast as cotton could be handled at conventional gins and perhaps much faster and at a fraction of the cost. If receiving stations could unload cotton much faster than conventional gins could, growers would not need as many trailers.

Longer seasons and periods of employment, ginning of larger volumes, gin ownership of cotton, and other factors would encourage the use of highly skilled labor and make employment in central gins more attractive to workers. At conventional gins, night crews are commonly employed for about a month, and most of the day crews work for between 2 and 4 months. A 5-month season at central gins would be a substantial improvement, especially for night crews. A 9- to 11-month season would amount to about full-time employment, if time for repairs and for vacations were included.

Gin ownership of seed cotton would reduce the pressure to rush cotton through gins. The pressure to gin a large volume of cotton during harvest would be replaced by efforts to gin at a speed practicable for fiber quality preservation as well as for using labor and equipment efficiently. In this way, ginners could realize the largest net return from the cotton and the gin. For example, at central gins, scheduling of work might permit ginners to dry cotton slowly for a number of days after receiving it, clean it while dry, humidify it for days, and then gin it.

In actual operations, perhaps some additional investments could be justified in central gins. For example, crusher rolls, such as those used in cotton mills for removing fine trash, could be expected to improve the quality of lint processed, and increase net returns.

Central gins could use computers or other advanced types of office equipment to reduce total costs of keeping their records and the records for receiving stations.

Part or perhaps all of the cotton handled by central gins could be ginned according to orders to meet specifications or on instructions from mills. Some cotton is sold to mills now on this basis, and the practice is sometimes called "custom ginning."

Central gins would have adequate volumes to support the use of standard or high density gin presses or make better use of new devel-

opments in bale presses. For example, fixed expenses on a new, high density bale press for gins that would make either standard or high density bales were estimated at $6,200 in 1958 (13, p. 23). Fixed expenses of $6,200 a year would average $1.03 a bale on 6,000 bales but only 17 cents a bale on 36,000 bales. Estimated fixed expenses of about $2,000 a year on a new regular or flat bale press would average 34 cents on 6,000 bales and about 6 cents a bale on 36,000 bales; that is, the difference in fixed costs would be 69 cents a bale on 6,000 bales, but only about 11 cents a bale on 36,000 bales.

The possibility of baling cotton into rolls of picker lap or round bales needs to be investigated for use at central gins. Such packaging may have important advantages, especially for cotton going to domestic mills.

Central gins could establish reputations for consistent quality, perhaps by use of brand names and specifications on fiber qualities.

With central ginning, less sampling of cotton would be required and the problem of damage from repeated sampling could be largely or entirely solved. Blending of cotton before ginning is largely responsible for the limited sampling required of bales of cotton in foreign countries where central ginning is used. In India, for example, only two to four bales per 100 are sampled (28, p. 100).

Automatic samplers, such as those developed by the U.S. Department of Agriculture, might be used in the United States for sampling a small portion of the bales at central gins. In this way, damage would be avoided to all bales at gins.

Bale weights could be limited to a narrow range at central gins. This would be made possible by the use of mechanical or automatic devices or by observations of experienced pressmen on large lots of similar seed cotton. Bale weights at conventional gins are now frequently related to the amounts of cotton on individual growers' trailers. This relationship would be eliminated at central gins.

Central ginning would practically eliminate the problem of two-sided bales (bales with a difference of one or more grades or staple lengths between the two sides). Mixed quality of cotton within bales is an important problem in some areas.

Problems of Selling Seed Cotton

In three studies made in the 1930's, the advantages and disadvantages of selling seed cotton to ginners were examined. The major criticisms of the practice were based on inability of growers and ginners to determine quantities of lint and seed or quality of lint at time of seed cotton sales (53, pp. 22 and 23; 34, pp. 62-64; 51, pp. 21 and 27). The researchers found that undesirable practices, such as equal prices for different qualities had developed in seed cotton sales. They recognized several advantages of seed cotton sales, but they concluded that these were offset by the impossibility of basing price on quality.

Quality of lint and quantities of lint and seed can now be determined for seed cotton, however, as shown by foreign practices and by the work of agronomists and others in this country. Both of these factors are covered in some detail later in this report. Prices can be based on both quality and quantity as determined by analyses of samples taken from seed cotton.

Foreign Practices Related to Central Ginning in the United States

Practices followed in foreign countries provide background information for application of central ginning in the United States. Of particular interest are practices followed in grading, storing, and blending of seed cotton.

Grading Seed Cotton

Seed cotton for central ginning is usually graded at time of sale or immediately after it is purchased. However, the factors considered and the extent of grading differ widely among countries.

Most cotton in Brazil is sold as seed cotton, and that country's price-support plan includes prices for seed cotton. In recent years, Government classers have been grading seed cotton as it arrives at gins in southern Brazil, and growers have been paid according to the quality of their seed cotton (77, p. 13). Samples of lint from bales are also classed.

In Argentina, seed cotton is graded before the independent firms buy it from growers (8, p. 96). In Colombia, the Government, through the institute for developing cotton (IFA), sets prices at the beginning of the season for three grades of seed cotton in each of three areas (8, pp. 248-250). Cotton is ginned in lots of the same seed cotton grade and moves to mills on the basis of seed cotton grades and types. Venezuela uses three grades for seed cotton, and guarantees prices on both seed cotton and lint (8, p. 221).

Representatives of the Ministry of Agriculture in Spain grade seed cotton into three grades as it arrives at gins, and growers are paid according to grade (89, pp. 13 and 14). Spain supports seed cotton prices at two levels, domestic and export.

Four grades for hand-picked and four grades for machine-picked seed cotton are used by Gosplan, the agency of the Russian Government that is responsible for buying seed cotton from farms, ginning, manufacturing, and supplying retail outlets, (68, pp. 22 and 26).

Foreign matter and moisture are important factors in Russian seed cotton grades. Maturity and staple lengths are included in lint evaluation, but apparently omitted in grading of seed cotton. This system of grading is likely used on about 7 to 8 million or more bales a year.

In Egypt, growers sort seed cotton on farms, and buyers grade it at gins (27, p. 72). It is stored in sacks by grades, then sorted or graded again before ginning. Official grades are not used for seed cotton in Egypt, but ginners and other buyers sort seed cotton into similar qualities.

Six grades are used for seed cotton in Sudan, and cotton is stored according to these grades to await ginning (78, p. 29). The seed cotton is graded on the basis of the grade the cotton is expected to produce after being ginned (25, p. 33).

In some of the other African countries, only two grades are used for seed cotton (78, pp. 26 and 27). Colored cotton is separated from white cotton by growers in some countries, and color is a major factor in seed cotton grades.

Cotton is usually sold as seed cotton by growers in India, but there is no official system for grading cotton of individual growers (45, pp. 8 and 9). Cooperatives have used grades that included lint percentages and cleanliness (or amount of trash), and a study on improvement of cotton marketing in India has recommended that grade standards be fixed for seed cotton (54, p. 212). Most seed cotton is sold at auctions in India, and quality probably influences prices paid to some extent.

Seed Cotton Storage

Methods of storing seed cotton at central gins vary. In Brazil and Egypt and in some other countries, seed cotton is stored in large sacks. In the late 1930's, each gin in southern Brazil was required to have separate bins for the four official grades of seed cotton (50, p. 21). At that time, some gins had seed cotton storage houses that would hold 1,500 to 1,800 bales. From 2,000 to 5,000 bales would be waiting to be ginned at some gins. Sacked seed cotton was stored in seed cotton warehouses on gin yards and covered with tarpaulins when receipts exceeded the capacities of bins. Most southern Brazilian gins were equipped with at least six seed cotton storage bins in the early 1950's (8, p. 53). Some also had seed cotton warehouses or sheds. Seed cotton was commonly delivered to gins in sacks.

In El Salvador, seed cotton is commonly stored loose in covered sheds or open bins in circles around the gins (88, pp. 18 and 19). Each gin has about a dozen seed cotton storage sheds that have a combined capacity of about 5,000 bales. In years of large crops, some seed cotton is stored on gin yards without cover.

Seed cotton is usually stored in the open in Guatemala where an effort is made to complete ginning during the dry season (88, p. 33). Little damage apparently occurs.

In Nicaragua, during the peak of the harvest, seed cotton is commonly stored in large wire bins without roofs (88, p. 9). Some seed cotton is stored in storage houses for ginning after the rainy season starts.

In Colombia, after seed cotton is classed, it is weighed, and the bags are emptied in the warehouse sections according to grade of cotton (76, p. 13). Cotton is ginned from warehouses on the basis of grade, and bales move to mill on the basis of these same grades.

In Russia, seed cotton is put through cleaners, extractors, and drum driers, if necessary, when it arrives at gins from procurement stations (92, p. 7). Some cotton goes directly to gins but most of it is stored in large stacks about 25 feet wide, 16 to 20 feet high, and 40 to 50 feet long. Conveyors are used to carry the loose cotton onto the stacks which contain over 100 bales of seed cotton when completed. The stacks are on raised platforms, and means are provided for ventilating the seed cotton when necessary.

Blending Seed Cotton

The term "blending," as used in this report in connection with central ginning, refers to mixing seed cotton before it is ginned for the purpose of producing uniform lots of bales. "Uniform lots" refers to bales having similar fiber characteristics rather than wide variations, and it does not indicate that most fibers are the same length. The size of such lots may range from a few up to hundreds of bales.

Blending or mixing of seed cotton is a common practice in most foreign countries where cotton is sold by growers before it is ginned. Some blending probably occurs wherever cotton is sold by growers as seed cotton. In some of the foreign countries, growers have small acreages--some have less than an acre. Mixing or blending is necessary in such cases to get bales of lint uniform enough to meet market demands, but in these and in other cases, it is done to produce uniform lots of many bales.

In 1940, Herrmann reported that southern Brazilian cotton had an "unusually good reputation" (50, p. 1). Probably one of the factors in attaining this reputation was the practice of mixing seed cotton of the same grade in bins before ginning. This practice is likely also to have accounted at least partly for the uniformity of Sao Paulo cotton, which Spiegel reported in 1949 as being greater than that of cotton from any State in the United States (87, p. 118, footnote). Barlow reported in 1952 that grading of seed cotton and storage by grades in bins was an important factor in

Brazil in turning out even running lots of cotton (8, p. 53).

Seed cotton delivered to Russian procurement stations is spread out and raked or forked (92, p. 7). When it is moved to storage in large stacks at gins, it is blended further during loading, unloading, and stacking, and also as it is being removed from stacks. Lint samples are taken only from every tenth bale, which reflects the uniformity obtained.

Buyers at gins in Egypt store seed cotton by grades, then blend it in mixing rooms before ginning it (27, p. 72). The lint is blended after ginning and before baling, and cotton bales are opened and blended again before being exported. Seed cotton is handled so that lots of 30 even-running bales are ginned (78, p. 38).

Cotton growers in Pakistan are not paid on the basis of quality for their seed cotton, but gin buyers in the northern part of the country sort each cartload on basis of grade and staple, and store it according to quality (23, p. 206). Each quality is thoroughly mixed, and uniform lots often are produced of about 100 bales.

The major cotton firms in India sort and blend seed cotton to prepare particular types in large lots (86, pp. 142 and 143). Lots of about 100 bales are common. Only two to four bales a 100 are sampled after ginning for trading purposes.

Continued blending of seed cotton in foreign countries indicates that these countries have found blending both practical and profitable.

Application of Central Ginning in the United States

The lower costs of central ginning, together with the other advantages discussed, indicate there is a strong economic basis for using it in the United States. This section is an examination and evaluation of procedures and practices that would be involved in changing to and applying central ginning in the United States.

Among the major procedures and practices that would need to be fitted to conditions in the United States or developed are (1) sampling and analysis of seed cotton; (2) storage of seed cotton; and (3) blending of seed cotton.

Location of Central Gins

Central gins could be nearer to oil mills and warehouses than most conventional gins now are, and could often be at the same location as oil mills or warehouses. This would reduce or almost eliminate present costs of moving lint and seed from gins to warehouses and oil mills. Receiving stations could be at the same locations as many of the present conventional gins.

Motor trucks and trailers would probably be the chief means of hauling seed cotton from receiving stations to central gins. Trucks could not carry their full-weight loads of loose seed cotton, but they could be fully loaded with seed cotton that had been baled at the receiving stations.

The cost of hauling seed cotton from receiving stations to central gins would be partly or entirely offset by elimination of the cost of hauling the cottonseed and baled lint to oil mills and warehouses.

Sampling and Analysis of Seed Cotton

The estimated costs in table 5 include the cost of analyzing samples of seed cotton. With central ginning, analysis would be required to determine the price growers would be paid for their seed cotton. The term "analysis" is used here rather than "grading" or "classing" because it would be necessary to consider characteristics in addition to those now considered in classing of lint. Percentage of lint, precentage of cottonseed, and moisture content are among the additional characteristics that would be included.

The Standards and Testing Branch, Cotton Division, Consumer and Marketing Service, U.S. Department of Agriculture, has made cotton fiber and processing tests on cotton on a fee basis for several years. Tests listed in Announcement No. 178, issued in 1965 (94), included classification of lint for grade and staple; micronaire readings on lint, strength test, and moisture test.

In 1952, tests were available for ginning of seed cotton samples to determine weights of cottonseed and lint and the percentage of lint, and for determination of foreign matter in unginned seed cotton.

SAMPLES

Complete or proven methods for taking satisfactory samples of seed cotton for use in central ginning in the United States are not available at the present time. However, indications are that satisfactory methods can be developed readily through research by known sampling techniques, experiments, and perhaps pilot operations. Comments on some of the problems involved, and suggestions on a few of the many possible approaches to some of the problems follow.

Seed cotton samples used for analysis would have to represent the characteristics of a grower's cotton within narrow ranges of tolerance on quality and quantity. This would be difficult because of the wide variation in the characteristics of cotton fibers and proportions of seed to lint within fields, among stalks, and even among bolls on a stalk. The seed cotton in a single trailer load may vary widely in moisture content, fiber characteristics, percent of seed and trash, and other characteristics. Since mixing before sampling at receiving points does not appear practical, some method would be needed for taking numerous small segments throughout the bale or load, or for taking a small proportion continuously.

Samples could probably be taken by a modified automatic sampler that takes small amounts at frequent intervals. Samplers developed or approved by the U.S. Department of Agriculture for peanuts, such as the rotary peanut sampler, might be modified to sample seed cotton. However, since cotton is so variable, this method might miss spots of cotton with certain characteristics or not take correct proportions of the various qualities. Taking more numerous segments would increase the probability that samples were representative.

Cotton samples taken continuously seem likely to represent the load accurately.

A sampling device that might be adapted for continuous taking of samples is the riffle-type sample divider. A series of about 8 to 12 riffle-type sample dividers could be arranged so they would continuously remove small percentages of the seed cotton. Each boll or lock of cotton coming to a divider would have a 50/50 chance of going to the next divider. A single riffle divider, like those used for reducing peanut samples, is shown in figure 1. Slots for seed cotton would be larger--perhaps between 3 and 8 inches wide--and most dividers would be both wider and longer. Other modifications might be needed, such as an electric motor to shake the dividers back and forth so cotton would move through. One or more small units of one, two, or three dividers might be required also to get the size of samples needed. Augers or other

RIFFLE-TYPE PEANUT SAMPLE DIVIDER WHICH
MIGHT BE ADAPTED TO COTTON SAMPLING

PEANUTS ENTERING ODD-NUMBERED SLOTS TO GO INTO BOX 1 AND OTHERS INTO BOX 2

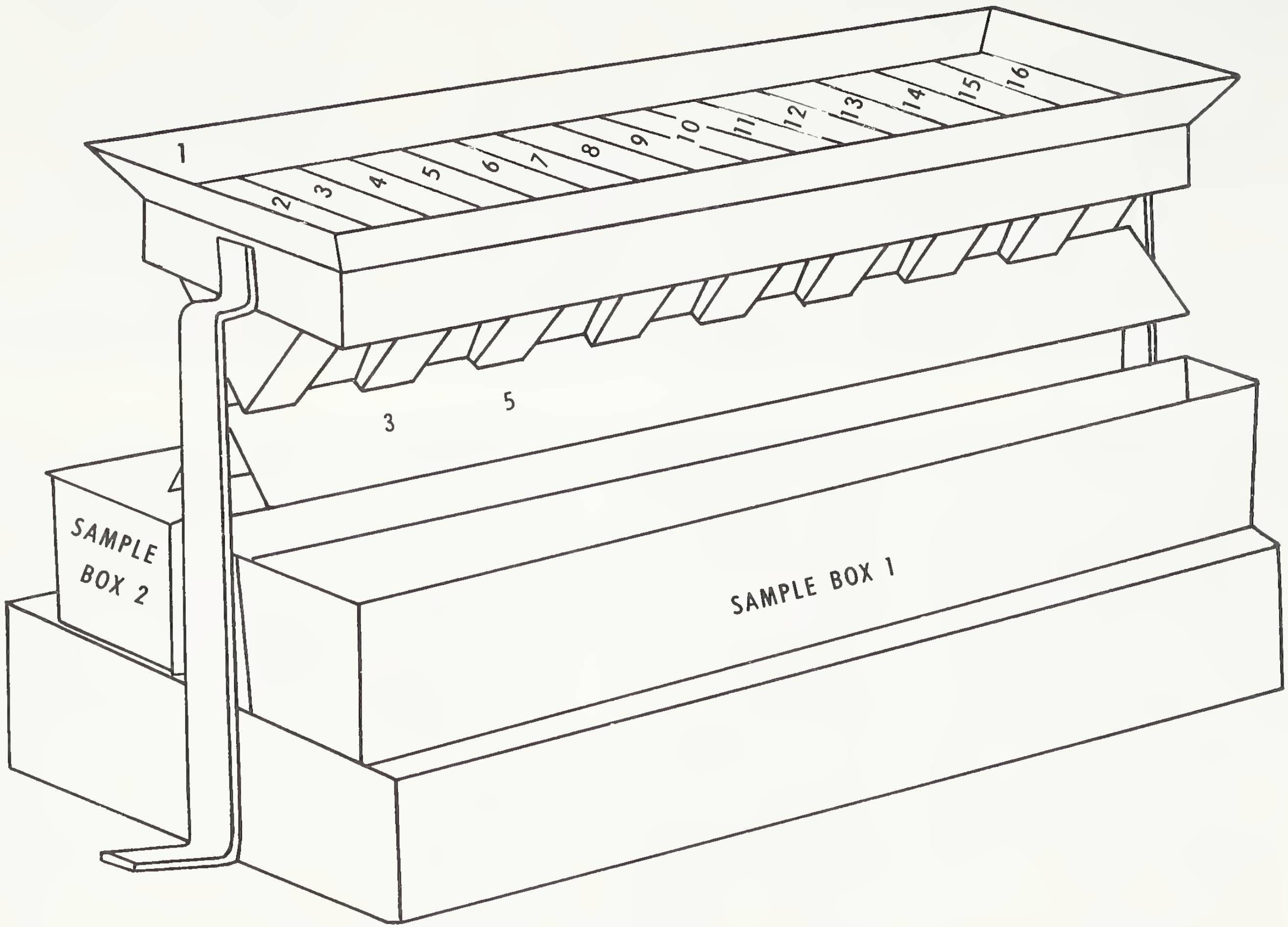

Figure 1

elevating equipment could be used to move the seed cotton to the top of the series of riffle dividers if necessary.

The series of riffle dividers could be used to take samples just before the seed cotton is baled. Other methods might be developed for sampling after cotton is baled. For example, if bales were rectangular, a sampler that removed small amounts with a suction pipe and vacuum might get satisfactory samples. Should round bale presses be developed for seed cotton, pie-shaped wedges cut from outside to center at one end of the cylinder would give a cross section of the bale. Such sections could be cut with power saws.

In practice it might be more convenient to take samples at some locations in the receiving stations than in others. Also, samples taken at some locations might represent the quantities and qualities of products more accurately than at others. Care would have to be taken to relate seed cotton samples to the weight of the seed cotton at the time the sample is taken.

To illustrate, assume a bale of machine-picked cotton will turn out 500 pounds of lint (not including weight of bagging and ties) and 850 pounds of cottonseed when ginned. Suppose it weighs 1,550 pounds when it arrives at the receiving station. Samples of seed cotton might be taken immediately after the seed cotton leaves the first separator, and analyzed on the basis of a total weight of 1,550 pounds. However, a rock and green boll extractor or airline cleaner, or both, may have removed 50 pounds of green bolls and other material during the time the cotton was moving from the trailer to the separator. Also, the air used in unloading the bale may have removed 1 percent or more of moisture and dust. In this case, accurate samples and an accurate analysis of the samples would not give correct results because the analysis would be used with an improper weight.

The size of seed cotton samples needed for central ginning would have to be determined by experiments or experience, or both. Several research workers have investigated the degrees of accuracy obtained from ginning various sizes and numbers of seed cotton samples, compared with ginning the cotton from which samples were taken in connection with cotton breeding work (81, pp. 157-163; 82, pp. 67-69; 96, pp. 531-533; 35, pp. 200-205; 56). Another worker investigated the size and number of samples required to give various degrees of accuracy in estimating average percentage of lint to expect at commercial gins in a season (18, pp. 211-213).

Although conclusions differed on sizes of samples required, about 2-pound samples were suggested most often. All these workers emphasized representativeness. One worker concluded that one representative sample from a lot, carefully handled, was adequate for accuracy needed in cotton breeding (96, p. 533). Samples used by the research workers were apparently taken at random by hand from mixed lots.

Highly representative samples of seed cotton would be needed for central ginning because of wide variations in the quality of lint; in proportions of lint, seed, and trash; and, consequently, in the value per pound of different loads. Duplicate samples might be needed in case one sample got lost or for other reasons.

If the seed cotton is baled for storage, samples taken just before the cotton enters the baler would correspond closely to bale weights taken soon after baling. Weights of wire or ties, bale covering (if used), and samples could be determined, and adjustments made if needed. Adjusting for these weights would be considerably easier and more accurate than adjusting for trash, dust, and moisture, as would be necessary if samples were taken after cotton had been through the first separator.

ANALYSIS

When cotton is ginned at conventional gins, the weight of the lint is determined by weighing

the bales. Cottonseed is weighed at some conventional gins, but, at many others, weight of cottonseed is estimated by formula. The qualities of lint are usually determined by classing a lint sample (cut from the two sides of bales) for grade and staple length. Micronaire readings are taken on most samples, and strength tests are taken on some. This is all the information generally used for selling lint and cottonseed of cotton ginned by the conventional method.

The inaccuracies involved in estimating the weights of cottonseed by use of ratios and formulas are widely known in the cotton industry. It is also commonly recognized that sometimes samples cut from the two sides of conventionally ginned bales do not accurately represent the cotton in the bales.

It appears that representative samples of seed cotton, accurately analyzed, and used with proper weights of the seed cotton would result in more accurate weights for cottonseed than the present use of ratios and formulas. The term "proper weights on seed cotton" as used here refers to weights taken on seed cotton either immediately before or after samples are taken so that the seed cotton and samples from it are in exactly the same condition as to moisture and foreign matter contents.

Seed cotton samples taken continuously through bales or even those taken at frequent intervals throughout bales seem likely to represent the lint in bales more accurately than two segments now cut from outsides of many bales. Accurate analyses of representative seed cotton samples and the use of proper weights on seed cotton would provide similar and perhaps more accurate information for use in sales than is now available from the system of sampling lint and estimating the seed weight which is used at conventional gins.

The analysis of seed cotton samples would include extracting, weighing, cleaning, and ginning of samples; weighing the resulting lint and cottonseed; and calculating the percentages of each for use with the proper weight of seed cotton. Analysis would also include classification of the lint from samples for grade and staple length, and determining of other characteristics by micronaire readings, strength tests, and so forth, as required.

Percentages of moisture in seed cotton samples, or loads, or both, would be needed for central ginning in the United States. Unless percentages of moisture are included in analyses and used in transactions on seed cotton, inequities and other problems would occur.

An example indicates the importance of moisture percentages in the analysis of seed cotton samples. Several assumptions are necessary because of the complex relationships involved. Assume that the two loads of seed cotton, bale A and bale B, belong to different growers, and each of these bales weighs 1,500 pounds when sampled and weighed at a receiving station. Assume that the analyses show that each of the two bales will turn out 33-1/3 percent lint (not including weights of bagging and ties) and 56-2/3 percent cottonseed. (This indicates that 10 percent foreign matter will be removed in ginning.) Assume that each of the three portions making up the seed cotton (lint, cottonseed, and foreign matter) of bale A contained 7 percent moisture when it was sampled and weighed and also when it was ginned and after it was ginned. But assume that each of the three portions in seed cotton of bale B contained 10 percent moisture when it was sampled and weighed but that all three portions dried to 7 percent moisture by the time they were ginned, and remained at 7 percent after they were ginned. Table 6 shows the effects of the differences in moisture content of the seed cotton in bales A and B on the weights of lint and cottonseed that resulted when the bales were ginned.

If the two growers in the above example received the same price per pound when their cotton was sampled and their cotton was of the same or equal quality, the grower of bale A received less than he should have received or the grower of bale B received more than he should have received.

Table 6.--An example of effects of moisture on weights of lint and cottonseed

Bale	Percentage of moisture		Weights of seed cotton		Weights after ginning (without bagging and ties)		
	When sampled	When ginned	When sampled	When ginned	Lint	Seed	Foreign matter
	Percent	Percent	Pounds	Pounds	Pounds	Pounds	Pounds
A	7	7	1,500	1,500	500	850	150
B	10	7	1,500	1,455	485	825	145

Automatic controls similar to those used to control temperatures of driers in gins, or other devices, might be used in receiving stations to record the average percent of moisture in bales or loads of seed cotton as they pass through the stations. Such records could be used to check moisture tests on samples and for such purposes as whether to gin or store cotton in a given load.

Moistureproof bags would be needed for samples of seed cotton on which moisture tests were to be made.

Small size or laboratory-type gins would be needed to gin the samples. Other equipment, of similar capacity, such as cleaners, extractors, and lint cleaners would also be needed for preparing the samples for ginning and for processing them after ginning. Used gin stands and other used gin equipment could be cut down in size for this purpose.

In recent experiments with a small laboratory gin and cleaners and extractors of similar size, results obtained were found to be representative of those obtained at a commercial gin (58). About fifty 1,000 gram samples, or 2.2 pounds, could be processed per hour on one unit.

Cooperatives or private firms might analyze seed cotton samples to start central ginning, or private firms or a Government agency might provide such services. Private firms now analyze samples of cottonseed for oil mills and gins. If a Government agency were used, the Cotton Division of Consumer and Marketing Service, U.S. Department of Agriculture, which now classes samples of lint cotton for growers and others, appears to be a logical agency for analyzing seed cotton samples.

Storing Seed Cotton

Maintaining or improving the value of seed and fiber of stored seed cotton is essential if central ginning is to be practical. Only a small amount of deterioration in the quality could be absorbed by central ginning before total costs would become excessive.

The quality of the stored seed cotton may be damaged by excess moisture content or by a combination of high moisture content and other factors. On the other hand, storage may diffuse moisture within the cotton so that its distribution is more uniform and quality is better maintained. Storage also permits blending of seed cotton, a practice that has a major potential for improving the uniformity among bales within lots.

WHAT IS EXCESSIVE MOISTURE?

Research on seed cotton storage has been concentrated largely on determining the percentage of moisture that cotton can contain for safe storage. Researchers have reported a rather wide range of conclusions.

Apparently, nearly all research workers would agree that cotton with 10 percent or less moisture content can be stored without damage. There are some who reported 12 percent as a safe level. Others considered 14 percent safe, and some reported no damage when cotton containing 17, 18, and up to 23 percent moisture was stored. One researcher concluded that excess moisture alone does not cause deterioration in lint quality of seed cotton, but that some combination of two or more factors--high moisture content, high temperatures, high humidity, and possibly micro-organisms--must be present to cause damage.[3]

In germination tests, two research workers found "percent emergence was generally unaffected by type of storage, length of storage, or moisture content of seed cotton when it entered storage" and they also found that oil milling quality was not affected by these same factors. (5, p. 8). Only about 5 percent or less of the cottonseed produced is used for planting. That portion of the planting seed saved from seed cotton with high moisture content in lint or seed could be ginned immediately or handled in some other special way.

MOISTURE CONTENT IN SEED COTTON DELIVERED TO GINS

Whatever the percentage accepted as the maximum moisture level for safe storage, it becomes a matter of great importance in central ginning to know how much seed cotton arrives at gins with moisture content in excess of that level.

Metcalf of Missouri made an analysis on the basis of 14 percent moisture as acceptable and reported that:

> The relationship between moisture level of seed cotton and relative humidity would indicate that only a small percentage of cotton, if any, reaches the gin with moisture content in excess of 14 percent (62, p.26).

His footnote on that statement is as follows:

> Actual records for three years from one gin in Missouri tend to validate this assumption, as approximately 1 percent of all cotton arrived at the scales with more than 14 percent moisture.

Metcalf also reported that seed cotton with 18.0 percent moisture at time of storage dried to 13.0 percent after 30 days storage (62, p.71). In the experiments he conducted in 1962, the design required at least half of the cotton to be harvested with 15 percent or more moisture. To get cotton with so high a moisture content, it was necessary to harvest some of the cotton immediately after a rain.

About the same maximum moisture level was reported by Moore after tests in Mississippi:

> Tests were made on 3 early-season, 3 mid-season, and 3 late-season machine-picked cottons. The moisture content of the seed cotton ranged up to 14 percent, which was as high as could be obtained with a mechanical picker under the conditions which prevailed during the 1949 harvesting season (69, p.2).

A survey in California of 47 gins in 1959 showed the following distribution by moisture

[3]The references on which statements in this paragraph are based are listed with pertinent findings in section II of the appendix.

content of seed cotton samples taken from trailers at gins in three periods (52, p.1):

Percent moisture	Percent of samples
6.0-6.9	1.7
7.0-7.9	12.7
8.0-8.9	33.0
9.0-9.9	29.7
10.0-10.9	13.6
11.0-11.9	6.8
12.0 and over	2.5
	100.0

Over three-fourths (77 percent) of the samples contained less than 10.0 percent moisture, and 97.5 percent contained less than 12.0 percent moisture.

A survey in Texas on the 1959 crop found the following distribution by moisture content of trailer samples for the entire State (11, pp. 45-48):

Percent moisture	Percent of samples
4.0 and below	1.8
4.1-5.0	4.3
5.1-6.0	9.5
6.1-7.0	10.8
7.1-8.0	10.6
8.1-9.0	18.7
9.1-10.0	21.1
10.1-11.0	12.6
11.1-12.0	9.6
12.1 and over	1.0
	100.0

The distribution for Texas was very similar to that for California except that over 10 percent of the Texas cotton had a lower moisture content than the lowest reported for California.

Weather conditions differ widely among areas within Texas. The High Plains and Rolling Plains are usually less humid than other areas. Seed cotton in these areas would usually have lower moisture content than in the State as a whole.

Power, Towery, and Hessler concluded that "Most cotton is harvested and ginned on the High Plains during dry climatic conditions resulting in sub-normal moisture content, often less than 4.0 percent" (79, p.55). On one of the days they charted, moisture in seed cotton ranged from about 6.5 percent at 9 a.m. to less than 5.0 percent at 3 p.m.

Central gins could process about 10 percent of their receipts for a 7-month season in the 3 peak weeks. In situations like those shown above for California and Texas, they could, by concentrating on higher moisture cotton, gin about all the cotton with over 11 percent moisture content in the 3 peak weeks. If exposure to air during unloading, reduced moisture content by 1.0 percent or more, all the remainder could be stored at 10.0 percent or less. Information on moisture content could be obtained by analysis or moisture meters at receiving stations.

Discounts could be used to cover additional costs caused by special handling of high-moisture cotton. Such discounts would discourage growers from harvesting cotton with high moisture content.

RELATION OF RELATIVE HUMIDITY TO MOISTURE IN SEED COTTON

Growers can usually avoid harvesting cotton with high moisture content by harvesting during periods of comparatively low humidity. Moisture in seed cotton, and especially in the lint portion, changes very rapidly in the fields or when cotton is fully exposed, and thus depends largely on the relative humidity of the surrounding air.

In a Mississippi study, Wooten and Montgomery found that by delaying machine-picking until relative humidity fell to 50 percent and by using only 5 gallons of moisture per bale for moistening spindles, seed cotton moisture could be held to 10 percent (100, p.4.) If 13.0 gallons of moisture were used for moistening spindles at that level of humidity, seed cotton

would contain about 11 percent moisture. In 1958, Riley and Williamson found that relative humidity was less than 50 percent in Mississippi during 35 out of 41 days in late October and November 1958. Cotton was expected to be dry enough to pick for an average of about 7.6 hours a day in defoliated fields and 6.7 hours in undefoliated fields before and after frost until about the middle of November and for an average of slightly over 4 hours a day from the middle to about the end of November. (84 p.5). The 1958 picking season was later than usual and earlier seasons would give more time for harvesting. Most cotton has been ginned before average frost dates in recent years. If the conditions reported by Riley and Williamson for 1958 are fairly representative, growers apparently have adequate time for harvesting their cotton during periods when relative humidity is below 50 percent.

In Missouri, McQuigg and Decker used relative humidity of between 55 and 60 percent to indicate when cotton would have about 8 percent moisture content (61, p.8). They found that in a summary of September and October for 5 years (1950-54) the relative humidity was 60 percent or less by 9:30 a.m. on about one-half of the days and by 11 a.m. on about two-thirds of the days. On clear and partly cloudy days, relative humidity remained low until about 6 p.m. in September and until 4:30 to 6 p.m. in October. If Missouri growers could harvest cotton with 8 percent moisture for an average of about 7 hours on 2 out of 3 days and for an hour or 2 more on half of the days, they would apparently have sufficient time for harvesting their cotton with 10 percent or less moisture.

If the acceptable limit of moisture content is 12 percent, more harvesting time is available to cotton growers for harvesting than if only 8 or 10 percent moisture levels are acceptable. If 14 percent moisture content is acceptable, much more time is available.

Riley and Williamson found that defoliation reduced humidity, and that defoliated cotton was dry enough to pick about 1 hour a day longer than undefoliated cotton (84, p.5). Parker and Wooten concluded that defoliation is an effective means of reducing moisture in seed cotton for harvesting (74, p.23).

LOWERING MOISTURE CONTENT OF SEED COTTON BEFORE AND DURING STORAGE

Kirk found that in the Lubbock area the burs and trash in machine stripped cotton contained about 45.0 percent of the moisture content (57, p.1). He found that when the burs and trash were removed from stripped cotton containing 14.1 percent moisture, there was only 11.5 percent moisture in the seed cotton. Stripped cotton containing 11.0 percent moisture contained only 9.3 percent moisture when the burs and trash were removed. These findings indicate that receiving stations could substantially reduce moisture content of stripped cotton by extracting burs and trash. Extraction of burs and trash would also reduce hauling costs and storage space.

In his Missouri tests, Metcalf found that using air to move seed cotton from trailers into baskets for storage reduced the moisture content by 2 percent (62, p.14). Bradley reported that moving cotton with air from trailers to baskets reduced moisture content by about 2 percent on cotton containing about 10 percent moisture (9, pp. 9 and 49).

Parker has recommended that seed cotton with over 14 percent moisture be stored in wire mesh containers not more than 4 feet deep or 4 feet wide (73, p.38), since engineers at Clemson, S.C., have found that air will penetrate loose seed cotton a distance of 2 feet. One lot of seed cotton baled with a hay baler in an experiment in New Mexico declined from 15.9 percent moisture content to 10.2 percent during storage (1, table 3). Moisture in two other lots of hay-baled seed cotton in that experiment decreased from 13.7 and 12.2 percent moisture when baled to 8.8 and 8.4 percent when opened for ginning. No special effort was made to dry the bales in that test. These tests were made in New Mexico to provide information for any growers who might need to store their seed cotton while waiting to get it ginned.

It has been suggested that seed cotton baled with hay balers could be stored on pallets for handling, storage, and drying while in storage (16, p. 272). None of the seed cotton compressed by hay balers would be as much as 12 inches from outside air. Hay bales would be somewhat similar to sacks of seed cotton stored in many foreign countries.

At times of low relative humidity, perhaps from 10 a.m. to 6 p.m. on most days, air could be circulated through storage buildings to dry the stored seed cotton. If circulating outside air of low relative humidity through storage buildings does not dry stored seed cotton sufficiently, commercial dehumidifiers may provide a solution. In some areas, one warehouse building equipped with warehouse size dehumidifiers might be able to dry more high-moisture cotton than would be received by a central gin.

Driers like those now used in ginning might be used at receiving stations to remove moisture from seed cotton. However, they may not be desirable for a number of reasons. They would add to the cost of building and operating receiving stations. Seed cotton passed through driers might be damaged by the combination of the moisture content remaining in the seed and the heat retained from the drier unless the cotton is cooled before storage. Drying damp cotton when it is mixed with dry cotton might overdry the dry cotton.

Driers designed specifically for drying seed cotton in storage, taking more time at lower temperatures, might prove practical. Such driers might be used in a warehouse at the central gin rather than in receiving stations.

New types of driers, such as infrared and electric ovens, might be adapted or designed for drying seed cotton for storage. Infrared equipment is now used in the textile industry for drying dyes, sizings, coatings, and resin-treated products, (55, pp. 68-73). Recent developments permit use of many techniques for infrared drying. One type of electric oven is reported to concentrate heat on denser portions of objects and might be useful for drying cottonseed as well as lint.

HUMIDIFYING STORED SEED COTTON

Moisture content of seed cotton may be too low part of the time in some areas for ginning without damage to fibers. As shown above, over 6 percent of wagon samples taken in Texas in a 1959 study contained 5 percent or less moisture (11). Power, Towery, and Hessler also found some cotton with only 3 percent moisture in bolls, lint, and seed while in the field (79, pp. 12-55).

In areas where seed cotton contains very low moisture in the fields or dries out in storage, the cotton may need humidification before being ginned to retain the original quality of the fibers. If air is used to move the seed cotton, it may further reduce moisture level from that in the field or in storage. Too little moisture may be quite important in some areas.

INCREASED UNIFORMITY OF MOISTURE CONTENT

Moisture migrates in seed cotton and tends to come into equilibrium with nearby cotton or, when the cotton is exposed, with the surrounding atmosphere. This has been observed in seed cotton transferred from trailers to baskets for storage, and it is likely that it occurs when the cotton is stored in bags or in hay bales. Long storage periods would increase the degree of uniformity in moisture content.

Wide variations in the moisture content of seed cotton as delivered to gins have been found. Neitzel reported that "The moisture content of seed cotton within one trailer can often vary from as much as 8 percent to 20 percent" (71, p.60). Prikosovits reported that variations of from 7 to 18 or 20 percent were not unusual in 5- to 7- bale trailers in Arizona (80, p.7). Ward and Graves found ranges in moisture content of 6.0 to 16.0 percent in Texas (97, p.4).

Ward and Graves found storage of seed cotton for 18 to 24 hours improved fiber length distribution and allowed use of less heat in ginning because of more uniform moisture content.

MICRO-ORGANISMS IN STORED COTTON

Parker reported that micro-organisms may be an important factor in quality deterioration of stored seed cotton (73, p.38). It will be recalled he reported excess moisture in seed cotton alone does not cause deterioration. Instead, he concluded that combinations of length of exposure to high moisture and high temperatures affected lint quality deterioration. He also concluded that in warm and humid climates fungi are likely to cause damage to stored cotton.

Altschul reported research conducted on reducing biological activity of stored cottonseed (2, pp. 192-196). Some of the results were encouraging, and that work may be useful in connection with storage of seed cotton.

Inert gas has been used for improving food preservation, and might also be used for maintaining the quality of stored seed cotton by controlling micro-organisms. Parker reported that, where fungi are present fungicides will reduce deterioration of seed cotton.

PROCESSING FOR STORAGE

The best methods for processing seed cotton for storage in the United States remain to be determined. Additional processing by harvesting machines, such as bur and green leaf extraction and baling attachments, may become important factors in central ginning. Seed cotton might be stored loose in cottonseed houses of oil mills or in warehouses of compresses with or without processing. It seems more likely with present harvesting machines that it would be processed to some extent, then baled. Baling would facilitate mechanized handling, assist in keeping qualities identified, and reduce storage space requirements.

With present harvesting equipment, receiving stations would probably have some extracting equipment. Rock and green boll traps are likely to be used for removing green bolls, especially in areas using cotton-stripping machines. Green leaf and stick machines would probably be used in machine-picking areas. They might also be used in areas where cotton is machine-stripped, but master bur extractors might be used instead, or both might be used.

A boll opening cylinder would probably be used in areas where cotton is machine-stripped. Seed cotton cleaners might or might not be needed.

Driers might be used, but extraction of green bolls, burs, and trash would reduce the need for drying.

A number of factors would influence the type of bales used for storing seed cotton. Hay balers can produce bales of 12 to 15 or more pounds density per cubic foot. Gin bale presses can make bales of 25 or more pounds density per cubic foot, but densities above 25 pounds may not be desirable as higher densities were found to damage seed in Arkansas and Oklahoma experiments (4, p.4, and 91, pp. 31-35). Waste paper balers may prove well suited for baling seed cotton and are largely automatic.

The shape and size of bales might prove important. For example, hay-baler bales could be dried out or humidified more readily than larger or denser bales, and their use would facilitate blending. Preliminary studies indicated a round bale packaging system for lint would reduce press labor 65 to 80 percent at high capacity gins, require much less horsepower, and facilitate blending at mills (70, p. 60). Perhaps round baling presses designed for seed cotton would have some of these and other advantages. As stated previously, round bales of seed cotton might provide good cross-section samples, and if they would unroll, they might facilitate blending. Sizes of bales or packages could be varied to suit the needs.

TYPES OF STORAGE

Existing warehouses at compresses could be used for storing seed cotton and also for storing baled lint following ginning. Seed

cotton pressed into bales of about 25 pounds density per cubic foot would require about one and one-half times as much storage space as the lint from the seed cotton when the lint is in flat or gin bales.

As stated previously, Taylor and Porterfield concluded from an experiment in Oklahoma that seed cotton could be stored outside with little risk of fiber damage in that area, if certain precautions were followed (91, p.39). This would apply in other areas with similar climatic conditions.

Temporary covers, such as tarpaulins or plastic sheets might be used to protect seed cotton or baled lint or both. Baled lint is frequently stored without shelter for short periods.

Blending Seed Cotton

Mechanized methods of blending seed cotton would be needed for central ginning in the United States as the hand methods of blending used in foreign countries would be too costly, and would be unsuited for use in this country. Machines for blending seed cotton would have to be developed, but their development does not appear to involve any problems that could not be solved with reasonable effort and expense. Experiments, research, pilot plant tests, and commercial operations would all likely contribute to finding which are the better ways.

Equipment and techniques now used in cotton gins and other industries might be modified and combined for blending seed cotton. For example, a series of bins for seed cotton might be fitted with modified seed cotton feed-control systems including variable speed drives. Broad belts or augers below the series of bins could carry the mixed or blended cotton from the series of bins to the gins. This would resemble the blending method used by some terminal elevators for blending grains. Many other combinations or designs might blend seed cotton satisfactorily.

Investments Required

Central gins could use a considerable proportion of the existing gin, warehouse, and oil mill facilities, and they would probably require relatively small additional investments. For example, many, if not all, of the present gins could be converted to receiving stations, machinery in some of the better gins could be used for the central gins, and the warehouses at compresses could be used for storing seed cotton as well as baled lint. Some of the equipment in present gins might be cut down in size for use in analyzing samples of seed cotton. New hay balers or other type presses might be needed. In a few areas, some additional warehouses might be needed also. But the reductions in overhead and operating costs of central gins and improvements in ginning services, such as blending, could be expected to make the additional investments well worthwhile.

Some Effects of Changing to Central Ginning

Concern has been expressed from time to time regarding what effect central ginning would have on the cotton industry and especially on conventional gins. This section considers briefly some of the results that might occur.

The lower costs estimated in this report for central gins compared to costs for conventional gins have not been proved yet in the United States by actual operations. Neither have the improvements anticipated from blending seed cotton, and from other practices that central

gins could follow. But it will be recalled that many foreign cotton producing countries continue to follow the central method of ginning when some of them at least could change to the conventional method followed in the United States.

If important reductions in conventional ginning costs could not be realized by central gins and/or if important improvements could not be realized in cotton fibers from blending and other practices possible at central gins, then an economic basis for development of central ginning would be rather limited, if not entirely lacking. In that case, conventional gin owners or other investors in conventional ginning would not need to be concerned about development of central ginning.

A change from conventional to central ginning would resemble, in some respects, other changes that economics has already produced in many other agricultural processes such as the replacing of local butcher shops by large packing plants and of local custom flour and meal mills by large specialized flour and feed mills. Although it would now be difficult to finance such local enterprises as these, most towns, many villages, and some crossroad points in cotton-producing areas are still supporting one or more local cotton gins.

If economies in cost of ginning and fiber improvements of even one-half as much as those estimated in this report could be realized by central gins, a strong case would exist for changing to the central method of ginning. Fiber improvements would strengthen the competitive position of cotton. The benefits realized from reducing the costs of ginning would be divided in various ways, depending on the specific conditions and situations. The growers would probably receive a substantial proportion of the benefits since they now pay the ginning costs, but other segments would also realize benefits in many cases.

Changing from conventional gins to central gins would affect, in numerous ways, the operations of cooperatives and others who operate gins, compresses and warehouses, and oil mills, and also cotton merchants, depending on extent of their integration at present and the integration that they might develop and on other conditions. Only the effects on different type of gin ownership and integration will be discussed briefly here.

The effect of changing from conventional gins to central gins would not differ on the whole as far as values are concerned, for different type owners. Gin ownership may be classified into three major types--individuals and partnerships, companies or corporations, and local cooperatives. An example will illustrate why the effect on values is not expected to differ by ownership types. Assume that in an area a company owns six conventional gins and that six individuals and/or partnerships and six local cooperatives each own a conventional gin--making a total of 18 gins in the area. Assume that the book value of each gin is $150,000. Suppose that the six gins owned by each type owner are replaced by one central gin as in table 5 (where it was estimated that one central gin processed as much cotton as six conventional gins). In that situation five gins of each owner type would become surplus. The values of these gins would be affected in a similar way and to similar degrees.

In the preceding example, the change itself might be accomplished most readily by the company in that the management could order the change made and the final decision would probably be made by one man or a few men. There would perhaps be some problems in getting agreement among the individual or partners to combine their interests, but comparatively few people would be involved directly in the decision. With the six cooperatives, however, perhaps 300 to 1,000 or more grower members would be involved. These hundreds of members would have to approve the change before the directors and management of cooperatives could convert to a central gin.

If this country would change to central ginning, the speed with which the change would occur would have important effects on conventional gin owners and others. The prospect of large reductions in ginning costs and large improvements in fiber value from blending

and other practices in some areas would likely increase the speed of the change much faster than in areas where costs are already low or where fibers are somewhat uniform. In any case, some time would be involved in making the changes and some gins might be depreciated out before or by the time the change to central ginning occurred. Some gin owners might anticipate this change and not replace some equipment that they would otherwise replace.

The size and volumes of central gins would tend to be determined by several factors. The ability of management would be one factor, as now, but perhaps more important than in the past. Density of production and transportation costs would be another factor. Isolation might limit the size of central gins in certain areas. The central gin data included in table 5 are not given as a model for either size or volume. Some central ginning cooperatives or other firms may have a number of gin batteries at one location and operate 10 months or more a year. Smaller gins than those given as examples in table 5 might be desirable in remote areas with small volumes, and some smaller gins might also be able to operate successfully in areas producing larger volumes. If larger capacity gins operated at sufficiently lower costs, they might be preferred for larger volumes. Whether a gin has a capacity of 5 or 20 bales an hour, costs are expected to be lower on volumes equal to several months capacity.

Central ginning might encourage some increase in integration. In some areas storage space would be needed for seed cotton by central gins but less space would be needed by merchants for storing baled cotton. This would probably encourage the integration of cooperative or other compresses and warehouses with central gins. Central gins would buy the seed in the cotton and consequently have the seed assembled at the central gins. Integration with a cooperative or other oil mill seems a logical step where such integration does not already exist. Cotton marketing cooperatives or cotton merchants and central gins would have common interests in making blends of seed cotton that mills would want and which would bring the best prices. Their integration would seem to combine ability to make blends with knowledge of demands of various cotton mills.

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Appendix

Section I discusses details involved in developing some of the costs shown in table 5 in the text of this report, and section II gives pertinent information on moisture content in seed cotton.

Section I. Procedures Used in Developing Costs of Ginning and Handling Cotton with Conventional and Central Gins

INVESTMENT AND OPERATING COSTS FOR CONVENTIONAL GINS

Ginning costs for the conventional gins were taken from Marketing Research Report (MRR) 640 (14, p. 12). The manner in which those costs were developed are explained in the text and appendix of that report. Briefly, these costs were estimated on the basis of a survey of costs during 1962 for 13 cooperative gins in the Lubbock area of Texas, supplemented by other data in the files of the Farmer Cooperative Service concerning gins in that area.

Investment cost of the 10-bale-per-hour size was estimated at $300,000.

Fixed costs in this report were all calculated at the following rates as in MRR-640 and FCS Service Report 67 from which some of these costs were taken:

Depreciation at 7 percent of investment, excluding land.

Interest at 5 percent on average or one-half of original investment in equipment and 5 percent on original cost of land.

Taxes ad valorem at 55 cents per $100 of original investment.

Insurance, at 45 cents per $100 on 80 percent of investment, less land.

INVESTMENT AND OPERATING COSTS FOR CENTRAL GINS

Costs for a central gin were first developed in a study made at the request of the Board of Directors of a cotton cooperative in the Lubbock area of Texas. The results of that study were published as FCS Service Report No. 67 in 1964 (15). The estimated costs for the central gin and a comparable conventional gin included in that report are reproduced in this report as table 7.

Data included in the Service Report were revised on the basis of other data that became available after 1964 and were used to develop table 5. Some detailed comments were included in the text of this report. Other details follow.

Managers' salaries, office salaries, office supplies, fuel and water and other (or miscellaneous) costs were not changed in table 5 from those in FCS Service Report 67.

The fixed costs were increased in proportion to the increase in investment of the central gin. Depreciation and interest were increased a few cents a bale, and the costs for season (in table 5) were also increased in proportion to fixed items, but taxes and insurance did not increase enough to change cents per bale when these were rounded to the nearest cent.

Table 7.--Comparison of estimated ginning costs of a conventional gin and a central gin with receiving stations, Lubbock area of Texas, 1963.[1]

Item	Single conventional gin, 6,000 bales		Central gin, 36,000 bales (with 7 receiving stations)	
	Total for season[2]	Cost per bale[2]	Total for season	Cost per bale
Variable costs at gin:				
Manager's salary	$ 6,000	$ 1.00	$12,000	$ 0.33
Office salaries	3,300	0.55	19,800	0.55
Gin labor	21,900	3.65	57,600	1.60
Office supplies	1,200	0.20	7,200	0.20
Repairs and gin supplies	9,000	1.50	36,000	1.00
Power	9,900	1.65	36,000	1.00
Fuel and water	1,800	0.30	5,400	.15
Other	5,100	0.85	16,200	.45
Total variable	58,200	9.70	190,200	5.28
Fixed costs at gin:				
Depreciation	20,280	3.38	20,280	0.56
Interest on investment	7,740	1.29	7,740	0.21
Taxes, ad valorem	1,680	0.28	1,680	0.05
Insurance	1,020	0.17	1,020	0.03
Total fixed	30,720	5.12	30,720	0.85
Total cost at gin	88,920	14.82	220,920	6.13
Difference in gross costs per bale in favor of central gin	--	--	--	8.69
Receiving station costs:				
Estimated operating costs of 7 receiving stations	--	--	81,000	2.25
Interest on investment in 7 receiving stations[3]	--	--	7,000	0.19
Allowance estimated to cover other costs on cotton going through central gin[4]	--	--	44,640	1.25
Total ginning and receiving	88,920	14.82	353,560	9.82
Net estimated difference in cost per bale in favor of central gin	--	--	--	5.00

[1] Source: FCS Service Report 67 (15, table 1, p. 3).
[2] This column of costs was first developed in MRR 640 (14, table 9, p. 12).
[3] Receiving stations estimated to cost $40,000 each; 5-percent interest rate on one-half of estimated cost was used to compute interest.
[4] Other costs would include sampling, sample analysis, additional insurance and storage costs, wire or twine for hay baler packages of seed cotton, and allowance for receiving station costs not covered by estimates.

Several assumptions made for the central gin in table 5 differed from those made in FCS Service Report 67. These changes, with estimated investment costs involved, are shown in table 8. A high-density gin press can produce savings for a cooperative or profit for another gin on a volume of 36,000 bales per gin; therefore, one was included in the assumptions.

It was assumed that each of the receiving stations would include a 7-cylinder incline cleaner, stick and green leaf machine, 14-foot bur extractor, and a rock and green-boll trap, and that these items would not be required in the central gin. The receiving stations were assumed to use wire to tie bales of seed cotton, made by the hay balers. Consequently, a magnet would likely be needed in the central gin to remove pieces of wire, so one was assumed to be included with the central gin (table 8).

No suction shed was assumed to be included but a blending room was included instead. Prices were not available for equipment

Table 8.--Changes made in the assumption for the central ginning equipment described in FCS Service Report 67 for the Lubbock area of Texas to convert it into the central gin used as a basis of estimates in table 5.

Changes	Effects on investments: Increased	Effects on investments: Decreased
	Dollars	Dollars
Installed a high-density gin bale press instead of a flat bale gin bale press. . .	[1]75,000	[1]25,000
Omitted standard gin unloader (#45-50 fan, 75-hp. motor, 2 telescopes, 2 Y- valves and piping)		[2] 4,915
Omitted rock and green boll trap and 2-hp. motor		[2] 830
Omitted 7-cylinder incline cleaner and 10-hp. motor .		[2] 5,980
Omitted stick machine and 10-hp. motor		[2] 4,075
Omitted 14-ft. bur machine and 15-hp. motor.		[2]10,750
Added magnet, after blending but before ginning at estimated cost of.	830	
Added blending equipment and changed suction shed to building for blending equipment at an estimated cost of.	12,720	
Total.	88,550	51,550
Net effect . . .	37,000	--

[1]Based on installed costs of $21,982 for a flat bale gin press and $67,715 for a high density gin press in California in 1958, as reported in baling cotton at gins (13, p. 20) and adjusted to estimated 1963 levels of $25,000 for flat bale press and $75,000 for high density gin press.
[2]Sources of these estimated costs were as given in Service Report 67 (15, table 3, p. 14).

designed specifically for blending seed cotton. Special equipment, however, such as hay feeding equipment or bins with feeder rolls similar to those from extractor-cleaner-feeders and variable speed motors might blend seed cotton satisfactorily. Gin conveyor belts or augers could move the blended seed cotton into gins. The amount of $12,720 was included for completion of blending room, blending equipment, and installation of that equipment, (table 8).

RECEIVING STATION INVESTMENT AND OPERATION COSTS

The items of standard gin equipment and other items included in assumed receiving stations together with estimated installed costs are shown in table 9. Motor horsepower was included for each item; total horsepower was 142. The land for a receiving station was estimated to cost $5,000. Pallets were included in receiving station investment costs since

Table 9.--Items included for 10-bale-per-hour receiving stations, estimated installed prices, and total estimated investment in 7 stations, area of Lubbock, Tex., 1963

Item	Estimated delivered and installed costs
	Dollars
Standard gin unloader (#45-50 fan, 75-hp. motor, 2-track-type telescopes, 2 Y-valves and piping) . .	[1]4,915
Rock catcher and green boll trap, 2-hp. motor	[1]830
Separator, 52-in. with 10 hp. motor	[1]2,410
Incline cleaner, 72-in., 7-cylinder, 10-hp. motor.	[1]5,980
Stick machine with 10-hp. motor .	[1]4,075
Bur machine, 14-in., 15-hp. motor	[1] 10,750
Hay baler, 16-ton size, 20-hp. motor	[1]3,500
Building, 25x25x30-ft.; steel and sheet iron; concrete floor	[1]4,500
4,500 pallets, 48x48-in., nonreversible hardwood with bale ties at $3.50	[2] 15,750
Forklift for yard tractor (to move and load pallets)	[2]1,000
Scales with printer for weighing pallets.	[2]2,750
Estimated investment in equipment and building per station. . .	56,460
Estimated investment in land per station.	5,000
Total investment per station. . .	61,460
Total investment in 7 stations. .	$430,220

[1]See FCS Service Report 67 (15, table 3, p. 14).
[2]Based on dealer quotations.

they would be used there first, for stacking hay baler bales of seed cotton. A tractor fork lift for moving pallets and scales for use with pallets was also included.

The total investment cost for a receiving station with items in table 9 totaled $61,460, and seven such stations would cost $430,220.

Variable costs for operating receiving stations included labor, power, wire (for tying bales), repairs, and maintenance. These costs totaled $10,962 a station for the seven stations which received a total of 36,000 bales--an average of 5,143 bales each (table 5).

Labor costs were estimated to include three man crews for 30 days and nights, and two-man crews for 36 more days of 12 hours, or 54 days of 8 hours or an equivalent combination before and after the peak. The three-man crews for 30 days would involve 2,160 hours of labor and the 2-man crew for 36 days of 12 hours or 54 days of 8 hours would involve 864 hours. The total hours of labor would be 3,024 hours, and at $1.50 an hour would cost $4,536 or 88 cents a bale (table 5).

Power consumption was estimated as follows:

142 total hp. x 0.75 = 106.5 kw. x 1 hr. = 106.5 kw.-hr.

106.5 ÷ 10 bales/hr. = 10.6 kw.-hr./bale

10.6 kw.-hr. at $0.03/kw.-hr. = $0.32 per bale.

While most electric rate schedules include a demand factor in calculation of charges, a kilowatt-hour charge gives an approximate cost for power.

Coils of wire containing 6,500 linear feet cost about $10 a coil in 1963. A coil would supply three wires per hay-bale-size package for about 17 500-pound bales of lint and would cost about 60 cents a bale.

Repairs and maintenance of receiving stations were estimated at 3 percent of the investment cost, less cost of land, which totaled $1,694 a station, or an average of 33 cents a bale on an average volume of 5,143 bales. This is about equivalent to the repairs and maintenance rate used on conventional gins.

Fixed costs on receiving stations were calculated at the rates shown above in this section of the appendix under "Investment and Operating Costs for Conventional Gins."

INVESTMENT AND OPERATING COSTS OF SAMPLE GINNING EQUIPMENT

The total investment cost estimated for one set of seed cotton sample ginning equipment and sufficient space for storing several hundred samples, was $12,500, as shown in table 10. A

Table 10.--Estimated investment for ginning portion of sample analysis equipment and building, and estimated operating costs, Lubbock, Tex. area, 1963

Items	Investment cost or operating costs: Total	Per bale
	(Dollars)	
Investment estimated required for ginning portion of seed sample analysis equipment and building space[1]	12,500	--
Operating costs for ginning seed cotton samples:		
Variable costs:		
Labor	6,552	0.182
Power (at 1.0 cent per kw.-hr., and motors totaling 10 hp)	54	0.001
Sample wrappers (at 1.8 cents each, including damage)	648	0.018
Repairs (at 3 percent of investment)	375	0.01
Total variable costs	7,629	0.21
Fixed costs:		
Depreciation (at 7 percent on investment)	875	0.024
Interest (at 5 percent on one-half of original investment)	312	0.009
Taxes (at 55 cents per $100 of original investment)	69	0.002
Insurance (at 45 cents per $100 on 80 percent of original investment)	45	0.001
Total fixed costs	1,301	0.04
Total costs of ginning seed cotton samples	8,930	0.25

[1]Equipment would include laboratory sizes (of about 15- to 20-inch width) of one or more cleaning cylinders, an extractor-cleaner-feeder, a 10- or 20-saw gin stand, lint cleaner, condenser and press portion of an automatic sampler. Building space of 10 x 20 feet is considered adequate for sample gin equipment and storage of several hundred seed cotton samples.

space 10 feet by 10 feet was reported adequate for operation of a set of this equipment. Samples could be stored in warehouse spaces when they exceeded space available in sample ginning space.

A set of sample ginning equipment would include one or more cleaning cylinders, an extractor-cleaner-feeder, a 10- or 20-saw gin, one or possibly two lint cleaners, and a condenser-packaging unit (perhaps like those used on automatic lint samplers). Scales, troughs, chutes, gates or valves, and piping would also be included.

This equipment is specialized and its cost depends on several variables. Used items of standard gin equipment might be cut down for this purpose if this were more economical.

At a capacity of 50 seed cotton samples (of 1,000 grams or 2.2 pounds) per hour (58, p. 1), one set of such equipment could gin 1,200 such samples in a 24-hour period, or 36,000 samples in 30 days and nights. That should be adequate on most days for the amount of cotton delivered to the seven receiving stations. The sample ginning equipment might need to be large enough to handle 50, 4-pound seed cotton samples an hour, so as to get two samples of about 10 ounces of lint each or possibly three samples of 7 ounces each.

Estimated costs of operating the sample ginning equipment are shown in table 10. The following assumptions were made concerning operation of the ginning equipment. Three men were used per crew and the sample gin operated day and night for 30 days in the peak of the harvesting season. A two-man crew was on duty the equivalent of 36 12-hour days or for 54 8-hour days (or with some combination of 8- and 12-hour days possible). The men in charge of ginning samples were paid $3.00 an hour because of the care and responsibility involved and the importance of this operation. Their assistants were assumed to be paid $1.75 an hour, and a helper during the peak season was paid $1.50 an hour. Labor cost was the major cost item for ginning samples and averaged 18 cents a sample, table 10. Labor costs equaled over 70 percent of the total estimated cost for ginning the samples.

Electric motors on sample gin equipment were estimated to total 10 horsepower, and use 7.5 kilowatts an hour. It was estimated that the equipment would gin 50 samples an hour; at this rate the sample gin would use 5,400 kilowatt-hours to gin 36,000 samples. At 1 cent a kilowatt-hour at the central gin (where the sample gin would likely be located) the power cost for the sample gin would be $54.00 for the season.

Numbered paper sample wrappers such as those used with automatic lint samplers were estimated to cost an average of 1.8 cents each which is about 38 percent more than they cost 5 years earlier (20; table 7, p. 21).

As indicated in table 10, repair costs for sample gins were calculated on the basis of 3 percent of the investment cost.

The fixed costs on the sample gin were calculated at the same rates used for the conventional and central gins and for the receiving station. These rates were as listed earlier in this section of the appendix under "Investment and Operating Costs for Conventional Gins."

COSTS FOR STORAGE, COMPRESSION, AND ASSOCIATED SERVICES

Most of the data available on storage compression and associated services were of a general nature, but some specific data were needed for analyses of these operations. Consequently, some estimates and assumptions were necessary.

Storage costs depend on when the crop is harvested and delivered for storage and when it shipped out which depends on the market conditions, including the government loan program.

The data on cotton ginned prior to specified dates in Lubbock County, Tex., from the 1963 crop (95; p. 37) were used to develop percentages of the crop ginned by months (table 11). The division between December and January on percentages of crop ginned was estimated.

Table 11.--Percentages of cotton ginned in Lubbock County, Tex., from 1963 crop, percentages on which receiving and storage costs were assumed due by months, assumed percentages shipped and carried over, for conventional and central gins

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
				Percent				
Conventional gins								
Amount ginned[1]	1	9	28	54	8	[2]	[2]	--
Receiving costs due	--	9	28	54	8	1	--	--
Storage costs due	--	9	28	54	8	1	--	--
Storage costs on amount of crop carried over from previous month	--	0	4	20	59	55	46	36
Total crop storage due	--	9	32	74	67	56	46	36
Assumed amount of crop shipped out in month	--	5	12	15	12	10	10	8
Crop carried over at end of month	--	4	20	59	55	46	36	28
Central gin								
Amount of 1963 crop received	--	9	28	54	8	1	[2]	--
Receiving costs on seed cotton	--	9	28	54	8	1	--	--
Storage costs on seed cotton received in month	--	9	28	54	8	1	--	--
Storage costs on seed cotton carried over from previous month	--	0	4	15	52	43	27	10
Total crop storage due on seed cotton	--	9	32	69	60	44	27	10
Crop ginned	--	5	17	17	17	17	17	10
Assumed amount of crop shipped out during month	--	5	12	15	12	10	10	8
Breakout cost due on seed cotton	(For season, assume 100 percent)							
Crop ginned and carried over on which receiving costs are due	--	0	5	2	5	7	7	2
Crop ginned and carried over on which storage costs are due at end of month	--	0	5	7	12	19	26	28
Total amount of crop carried over	--	4	20	59	55	46	36	28

[1]Based on data on ginning prior to specified dates, reported for Lubbock County, Tex., 1963 crop (95 p. 37) with estimated division of Dec. 13-Jan. 16 period.
[2]Less than 0.5 of 1.0 percent.

Receiving charges and the start of storage costs were assumed to correspond closely to percent of crop ginned (table 11). It was assumed that some of the crop was shipped out soon after delivery to compresses. Assumption of the percentages shipped were based on percentages of mill consumption by months, on bales mills had in storage monthly and on changes in numbers of bales in storage in compresses and warehouses in Texas (93, pp. 30, 34, and 35).

Compresses commonly charge storage for months or fractions of months. So the percentages of the crop on which storage costs were assumed to apply were developed by adding receipts and carryover and then deducting estimates of shipments by months (table 11).

Costs for receiving, storage, breaking-out, and compression were taken from a recent Department of Agriculture report (31, tables 4, 6, 8, 15, and 16 for the Southwest area) and shown in table 12 for conventional gin bales.

Part of these costs for conventional gin bales were changed for use in estimating costs for central gin bales. Receiving charges were left at the same level--63 cents a bale-since

Table 12.--Rates used for calculating receiving, storage breakout, and compression costs on conventionally and centrally ginned cotton in table 13

Items	Rates per bale
Conventionally ginned bales	Dollars
Receiving costs [1]	0.63
Storage costs per month [2]	.25
Breakout cost [3]	.45
Standard density compression [4]	1.37
High density compression [5]	1.87
Centrally ginned bales	
Receiving costs estimated (same as on bales since no sampling would be involved)	.63
Estimated storage costs--seed cotton bales (50 cents per month--5 cents for seed storage)	.45
Breakout cost estimated on seed cotton bales--33 1/3 percent more to allow for extra weight	.60
Receiving bales not shipped when ginned (carried over at end of month)	.63
Breakingout bales not shipped when ginned (carried over at end of month)	.45
Compression from standard to high density [6]	1.00

[1] Source: 31, table 4, p. 10. Southwest area.
[2] Source: 31, table 6, p. 12. Southwest area.
[3] Source: 31, table 8, p. 14. Southwest area.
[4] Source: 31, table 15, p. 21. Southwest area.
[5] Source: 31, table 16, p. 22. Southwest area.
[6] Estimate based on five men using a clamp truck, and on the high density gin bale press pressing 15 bales an hour from standard to high density.

sampling of seed cotton was done at receiving stations and samples would not be taken on arrival at the compress.

Storage costs for seed cotton bales were increased to twice those for conventional bales, but 5 cents a bale was deducted as estimated storage cost that oil mills would have had on seed from bales ginned at conventional gins (table 12).

Breakout costs on seed cotton were increased from 45 cents for conventional bales to 60 cents for seed cotton bales or by 33 1/3 percent (table 12). This was assumed to cover the added costs of hauling greater weights.

Receiving costs and breakout costs at the same rates as for conventional bales (63 cents and 45 cents a bale) were used for calculating costs on central gin bales that went into storage after ginning rather than being shipped (table 12).

Shipping costs were assumed the same on both conventional gin bales and central gin bales and were not included in table 13, since they would offset each other.

Compression costs were assumed to apply to all conventional gin bales with 40 percent being compressed to standard density for domestic shipment and 60 percent compressed to high density for export, since most of the cotton in the Lubbock area is usually exported (table 13).

Since the central gin had a high-density gin press, it could produce either standard or high-density bales at the time the cotton was ginned. Furthermore, a large proportion of it could be pressed to the density needed for the shipment because it was shipped as ginned. Of the 28 percent of the crop ginned and in storage from the central gin at the end of April, it was estimated that one-half or 14 percent would require compression to high density. When the destination of cotton was unknown and the manager did not want to risk compressing it to high density at the time of ginning, it was compressed only to standard density.

The cost for compressing the central gin bales from standard to high density was estimated at $1 a bale. That estimated cost was based on the central gin high-density press being idle (all seed cotton on hand was assumed ginned before the end of April) and it was estimated that five men could press 15 to 20 bales an hour. Power costs would be less than 5 cents a bale for the press, and labor and use of clamp trucks would account for most other costs.

Table 13.--Estimated costs at compress used in table 5 for receiving, storage, breakingout and compressing, based on 36,000 bales, for conventional and central ginning, Lubbock, Tex., area, 1963 crop.

Costs for conventionally ginned cotton			
Receiving costs on 100 percent or 36,000 bales at $.63[1] =			$22,680
Bales with storage due on or before May 1, 1964 (bales received during month plus bales carried over from preceding month)			
For October, 9 percent of 36,000 bales	= 3,240		
For November, 32 percent of 36,000 bales	= 11,520		
For December, 74 percent of 36,000 bales	= 26,640		
For January, 67 percent of 36,000 bales	= 24,120		
For February, 56 percent of 36,000 bales	= 20,160		
For March, 46 percent of 36,000 bales	= 16,560		
For April, 36 percent of 36,000 bales	= 12,960		
Total bale--months of storage	115,200 at $.25[1]		28,800
Breakout on 72 percent, of 36,000 bales	= 25,920 bales at $ .45[2]		11,664
Compression, estimated 40 percent standard density or	14,400 bales at $1.37[1,3]		19,728
Compression, estimated 60 percent standard density or	21,600 bales at $1.87[1,3]		40,392
Total costs			$123,264
Average per bale (using 36,000 bales)			3.42
Costs for centrally ginned cotton			
Receiving costs for baled seed cotton on 36,000 bales at $.63		=	$22,680
Storage due on seed cotton (month received plus carryovers)			
For October, 9 percent of 36,000 bales	= 3,240		
For November, 32 percent of 36,000 bales	= 11,520		
For December, 69 percent of 36,000 bales	= 24,840		
For January, 60 percent of 36,000 bales	= 21,600		
For February, 44 percent of 36,000 bales	= 15,840		
For March, 27 percent of 36,000 bales	= 9,720		
For April, 10 percent of 36,000 bales	= 3,600		
Total bale-months of storage	90,360 at $.45[4]	=	$40,662
Breakout costs on seed cotton for season, 36,000 bales at $.60[4]		=	21,600
Receiving charges on centrally ginned bales stored			
For October, -- none			
For November, 5 percent of 36,000 bales	= 1,800		
For December, 2 percent of 36,000 bales	= 720		
For January, 5 percent of 36,000 bales	= 1,800		
For February, 7 percent of 36,000 bales	= 2,520		
For March, 7 percent of 36,000 bales	= 2,520		
For April, 2 percent of 36,000 bales	= 720		
Total bales received	10,080 at $.63	=	6,350
Storage due on centrally ginned bales that were stored to May 1			
For October, -- none			
For November, 5 percent of 36,000 bales	= 1,800		
For December, 7 percent of 36,000 bales	= 2,520		
For January, 12 percent of 36,000 bales	= 4,320		
For February, 19 percent of 36,000 bales	= 6,840		
For March, 26 percent of 36,000 bales	= 9,360		
For April, 28 percent of 36,000 bales.	= 10,080		
Total bale-months of storage	34,920 at $.25	=	8,730
Compression to high density from gin standard density, 14 percent of 36,000 bales at $1.00 a bale or 5,040 bales x $1.00[3,4]	=		5,040
Total costs			105,062
Average per bale			2.92

[1]Percentages from table 11 and rates from table 12.

[2]Breakout costs included only to May 1 since breakout costs on 28 percent of cotton crop in storage May 1 assumed same for both type gins.

[3]Compression charges are included on all bales to place conventionally and centrally ginned cotton on similar positions. Shipping costs on ginned bales in storage May 1 were assumed the same for both type gins. Shipping costs on conventionally ginned bales and costs for moving bales from central gin for shipping were assumed equal and neither was included.

[4]See rates in table 12.

Section II. Pertinent Information on Moisture Content in Seed Cotton[1]

1. "Moisture content of seed cotton in the Arkansas [storage] tests ranged from around 7 to 9 percent for the low moisture cotton to as high as 23 percent for the high moisture cotton. That used in the Missouri test ranged from 11 to 18 percent at time of harvest. . .

"Information on grade and staple, support prices for these grades and staples, fiber property tests, and spinning performance tests indicate that there was no discernible deterioration of fiber during storage of seed cotton regardless of the moisture content, type of storage, variety, or length of storage. . ." (See 3., p. 20).

2. Of 150 lots stored during 4 years in Arkansas tests "---only 21 recorded internal temperature build-up. Cotton in four of these 21 had less than 20 percent moisture as determined by the oven method---"

"Standard quality measurements indicated that heating resulted in either an improvement or no change in fiber length, fiber strength, yarn appearance, nep count and picker and card waste. The lint was slightly lower in reflectance (Rd) and higher in off-whites (+b). There was essentially no difference between heated lots and their controls in average break factor of yarns---

"In comparison to the price of lint for control lots, price of lint exposed to heat during storage was 0.37 of a cent per pound higher in 1961, 0.17 higher for packages (baled) in 1962, 1.23 cents lower for the bulk storage in 1962, and 1.59 cents lower in 1959." (See 6., p. 4.)

[1]Numbers in parentheses following the information refer to corresponding items in the literature cited (p. 30) of this report.

3. "Moisture content of the seed cotton when packaged [for storage] as determined by the oven method, ranged from 12 to 23 percent. . .

"From a price standpoint the longer the seed cotton was stored the higher the grade classification and value of lint compared to the control lots. . .

"---In calculating price, the staple length was held constant as it was not affected by storage.

"Due to grade differences the value of cotton stored 3 days was $1.00 per bale less, and that stored 94 days was $2.70 more than the value of the respective control bales.---

"---In only 5 of the 30 packages was there any internal temperature build-up. Maximum temperatures were 125° F. for one package, 116° for another, and from 108° to 110° F. for the other three--Packages that 'heated' contained seed cotton with 20 to 23 percent moisture content. However, some packages of seed cotton with more than 20 percent moisture had no internal heat build-up." (See 7, p. 3).

4. "Storage of mechanically harvested cotton having as high as 14 percent moisture content is technically feasible without the need of conditioning prior to or during storage. The accompanying reduction in moisture during storage of a minimum of 2 weeks results in average grade improvements of 1/3 grade without any effect on free fatty acid in cottonseed--" (See 40, p. 7.)

5. "In predicting whether seed cotton may be safely stored, the 12 percent seed moisture content is a rough dividing point. Seed cotton with seed containing less than 10 percent of moisture may be safely stored, but seed cotton with seed containing more than 14 percent moisture may be expected to stain. . ." (see 41, pp. 8-9.)

6. "The basic recommendation for storing seed cotton is as follows: Seed cotton may

be considered safe for storage if the moisture content of the cottonseed is below 10 percent and remains so throughout the storage period; as the cottonseed moisture content increases the risk of storage damage also increases." (See 42, pp. 9-10, and 28-29.)

7. "Seed cotton containing less than 14 percent of moisture can be stored for extended periods without injury to grade, spinning qualities, milling properties, or viability of the seed, but there is some evidence to indicate that extended storage may slightly decrease staple length." (See 59, p. II.)

8. "Moisture content of cotton stored [by Mo. Agr. Exp. Sta.] ranged as high as 18 percent."

"After 120 days of storage all cotton was valued at about the same value as prior to storage---. Implications are that over time, no costs or value deterioration must be accounted for due to loss of value of cotton stored prior to ginning." (See 63, pp. 239-245.)

9. "Although the spinning tests have not been completed, the results thus far indicate that machine-picked cotton of as high as 14 percent moisture content may be stored successfully without damage to the lint or seed after having been passed through a conventional seed cotton drier at 180° F. and placed in bins without further treatment.

"Grade improvement was noted on all lots stored for 1 or 2 weeks after which period there were no additional benefits. In some instances these grade benefits amounted to as much as 2/3 grade, but the average benefit for the season was 1/3 grade after 1 week of storage. There was no significant free fatty acid development in the cottonseed during the storage period. The moisture content of the seed cotton was reduced in the case of the undried, untreated lots from almost 12 percent moisture at the time of storage to 10 percent in 1 week. . ." (See 69, p. 3.)

10. "---the following basic factors affect the quality of stored seed cotton---

"Moisture content of the seed cotton; temperature to which the seed cotton is exposed; and humidity to which the seed cotton is exposed.

"Possibly the most important factor which should be added to the above list is the presence of micro-organisms in the seed cotton.

"Defoliation is the most effective means available of controlling seed cotton moisture.

"Even when the cotton is defoliated, some producers still pick cotton containing more than 14 percent moisture. To minimize deterioration of this high moisture seed cotton, the producer has several practices at his disposal." (See 73, p. 38.)

11. "Only a small percentage of the total cotton crop is harvested when it contains excessive moisture. . ." (p. 2.)

"...Defoliated cotton harvested when it has a moisture content of 10 to 12 percent would result in the maximum overall quality of cotton. Storage of this cotton would then have no effect on any of the lint or seed characteristics mentioned." (p. 24.) (See 74, pp. 2 and 24.)

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Other Publications Available

Effects of Electric Rates on Power Expenses of Cotton Gins -- Arkansas, Oklahoma, Texas. Marketing Research Report 470. John D. Campbell.

SWIG -- Southwestern Irrigated Cotton Growers Association, El Paso, Texas. FCS Circular 29. Otis T. Weaver.

Power Expenses of Cotton Gins by Types of Power -- Arkansas, Oklahoma, and Texas. Marketing Research Report 520. J. D. Campbell.

Costs of Ginning Cotton by Cooperatives at Single-Gin and Two-Gin Plants, California and Texas, 1962. Marketing Research Report 640. John D. Campbell.

Cotton Cooperatives on the Plains of Texas: Services and Benefits. FCS Circular 33. Henry W. Bradford.

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